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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 816

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. ▼ January 19, 1920

STREET TREES

By

F. L. MULFORD, Horticulturist

Office of Horticultural and
Pomological Investigations

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IMPORTANCE OF SHADE TREES.

THE COMFORT to be derived from shade trees has long been recognized. The early settlers of this country saved fine trees about their homes, on the village greens, along the country roads, and in the fields. Later, as villages grew, the householders planted trees adjoining their properties, and the result has been the beautiful elm-shaded villages of New England, the maple-shaded towns of New York and the Ohio Valley, and the oak-shaded streets of the Southeastern States. (Fig. 1.)

With time, the villages and towns became cities, and the woodlands were largely destroyed. Conditions for tree growth were less favorable in the cities, and nurseries had to be depended upon for planting material. With these changed conditions the native trees of a region became less dominant in the city planting and were largely replaced by those trees listed in nursery catalogues which took the fancy of each property owner along the street. (Fig. 2.) The quickest growing trees were considered first, and as some of these made a big showing the first few years and were easily transplanted, they have become the dominating trees in street planting from the

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FIG. 1.—An oak-shaded street in the South. Willow oaks in Birmingham, Ala., in late summer.

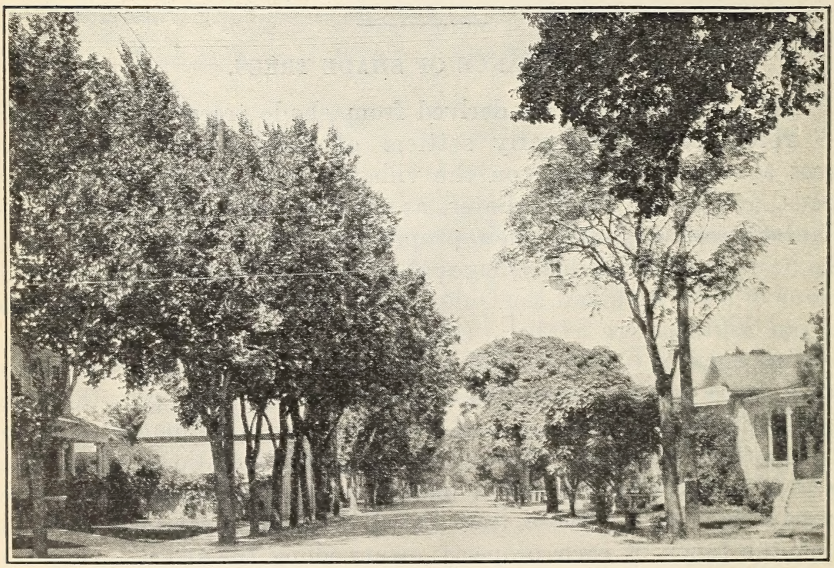

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FIG. 2.—A street with mixed plantings. The trees are of different kinds, some unsuited for the purpose, planted at varying distances apart, according to the inclination of the property holders. A street in Stockton, Calif., photographed in early summer.

Atlantic to the Pacific and from the Great Lakes to the Gulf of Mexico. (Figs. 2, 10, and 13.) A few have planted better and more lasting trees (figs. 1, 3, and 4); but the tree growth on the streets of the average town or city is ragged and unkempt in appearance, while that of the suburb or small village is not much better unless the planting has been done under municipal control and the plantings on a street have been confined to a single kind of tree.

The advent of such civilizing agencies as the telegraph, the telephone, the electric light, and the trolley car have added each its share toward the mutilation or destruction of the good trees that were in existence at the time of their coming. Faulty methods of

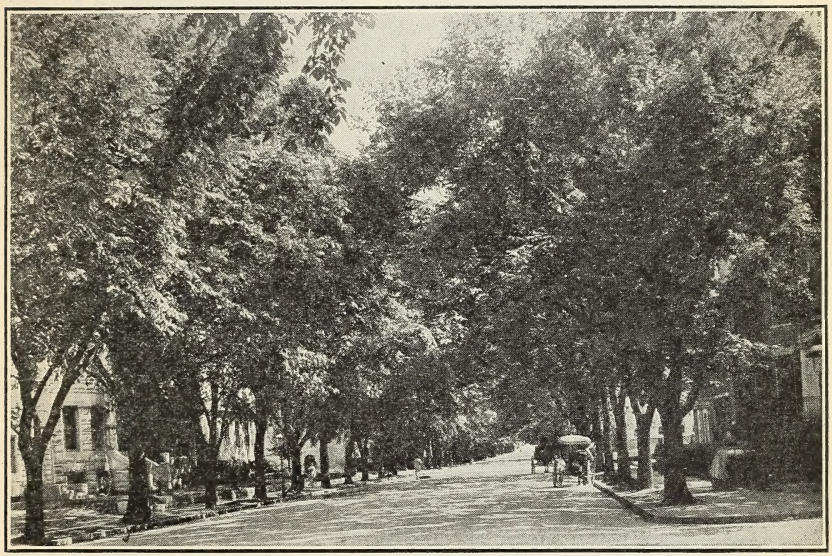

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FIG. 3.—American elms on a city street in midsummer. All these trees were planted at one time at uniform distances apart by the Commissioners of Washington, D. C.

pruning also have caused much disfigurement and ruin. (Figs. 5 and 21.) To this mutilation has been added the unnecessary destruction of many trees in centers of business (fig. 6), because they excluded a little daylight, or made a store less prominent, or were somewhat in the way of using the sidewalk for merchandise.

In spite of all these troubles tree planting has continued because people love trees, enjoy well-shaded streets, and are willing to make efforts to get them. The trees on well-shaded streets are not only pleasing, but also contribute toward the health of the community by transpiring moisture into the atmosphere and by producing a restful effect on eyes and nerves. Red, especially, is known to have an exciting effect on human beings, and where city streets are well

shaded it makes less prominent those colors that might otherwise prevail and offend.

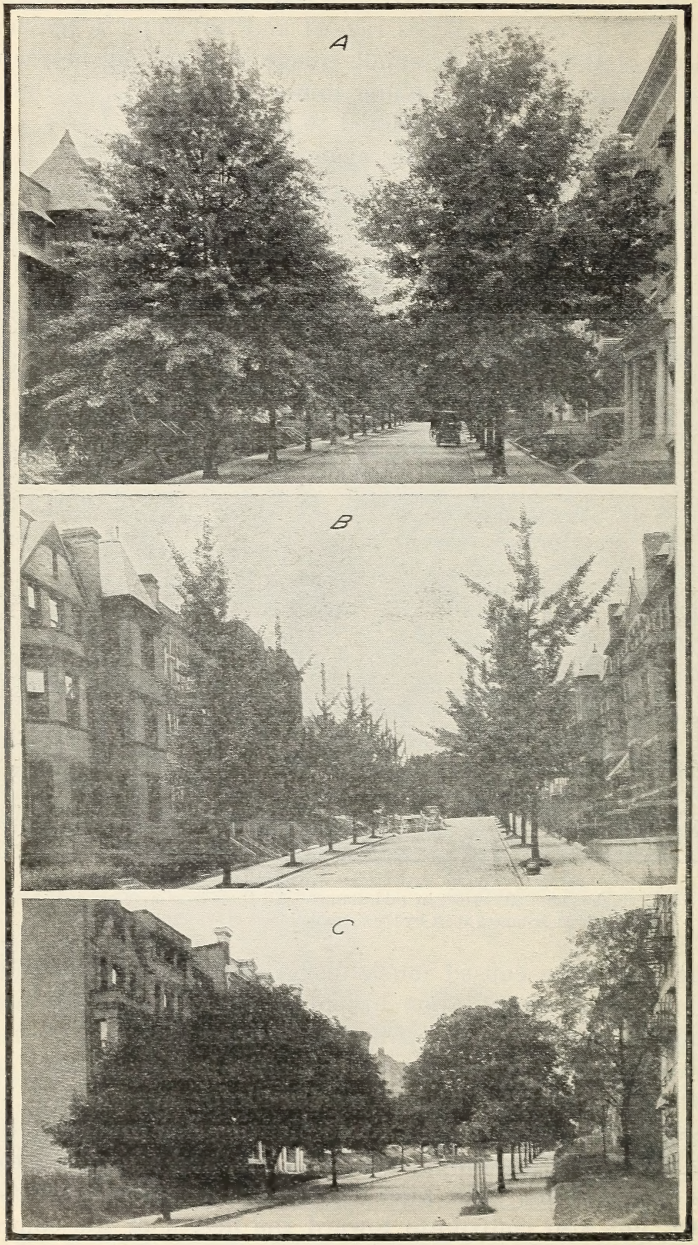
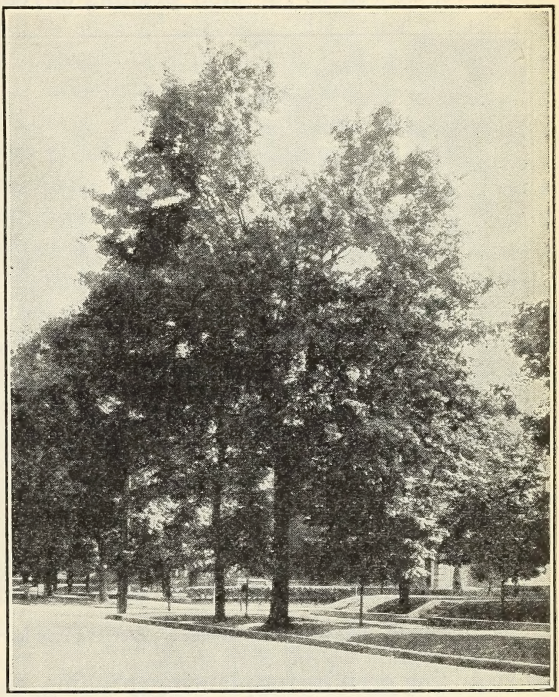


FIG. 4.—Trees 18 years old on adjacent streets: *A*, Pin oaks; *B*, ginkgos; *C*, Norway maples. Note the differences in size.

Good shade is so appreciated that its presence adds a value to adjoining properties. Real-estate men recognize this factor and plant shade trees as early as practicable on land which they develop. That the beauty of a city is improved by good street trees is becoming recognized more and more and is finding expression in the desire of garden clubs, civic improvement associations, and boards of trade for information on this subject.

Success in planting street trees can be attained only by planning and controlling the planting as a whole, by selecting the most suitable varieties, by securing trees in the best condition and planting them properly, and by giving the necessary later care.



P16692HP

FIG. 5.—A tree mutilated by linemen. An otherwise beautiful red oak in Louisville, Ky., as it appeared in midsummer.

While towns were small, conditions for tree growth favorable, and woodlands plenty, so that native trees were easily obtained and started, the practice of each householder planting his own trees as he saw fit gave good results. As towns became larger and impervious pavements took the place of earth roads, the conditions for tree growth became more severe and the results from the individual planting of trees less uniform. In large cities the conditions to be met are so extreme that it has become practically impossible for the average householder to grow street trees successfully, or to do so only at excessive cost. Then, too, a lineman in a few minutes often undoes what the individual has achieved with care and years of patient waiting (see fig. 5). The trees and the lines are both needed by the public, but when provided by individual initiative at private expense, but trimmed for the benefit of electric lines by employees of corporations intent on maintaining service at the least cost, the trees suffer unduly.

In order to have good shade trees at a reasonable cost which receive timely and efficient attention, with the effective control of wire lines, the care of the trees needs to be vested in some adequate authority.

PUBLIC CONTROL OF STREET TREES.

Providing shade on city streets is as much a municipal function as providing lights or sidewalks and should, therefore, be cared for by public officials. All street trees should be directly under the care of duly appointed officers, who should be responsible for their planting and care, as well as for their pruning or removal. Negative control

P16986HP

FIG. 6.—A desert of asphalt in the business center of a city having less than 100,000 population.

by requiring permits for planting, pruning, and removal is little better than no control.

The officials in charge should have the necessary authority and should be required to initiate and carry forward planting and all other needed work connected with the establishment and maintenance of street trees. Probably the most satisfactory way of securing supervision is through an unpaid commission of three or five members, which in turn employs an executive officer. In a small place a commission of three persons may be best, one being appointed every 2 years for a 6-year term. In large places five members may be better, and the ideal term would be 10 years. A compromise would be a 5-year term, a new member being appointed each year. The great need of long-term appointees is that it takes two or three years for a member of such a board or commission to see and realize the things

needed to be done and the policies that should be carried out. Because it takes a long time to get results in growing street trees, the policies should be as nearly continuous as possible and the terms of the members long enough to insure a majority of experienced persons on the board at all times.

The method of appointing the commissioners is not so important as that each shall be selected from the territory as a whole rather than from a part of it. In some places where the term of service is 10 years, each one's successor is appointed by the remaining commissioners, subject to confirmation by the court. Where this is done a member is not permitted to succeed himself. In other places the commission is appointed by the court; in others, it is elected by the city legislative body or is appointed by the mayor subject to the approval of the legislative body. The important point is to keep the administration as nearly as possible on a purely business basis.

A good board can accomplish nothing without liberal funds. There are two methods of providing these: (1) By an appropriation from the general tax levy and (2) by direct assessment against the properties, collectible with the other taxes. If the funds are provided by appropriation, a fixed minimum, expressed in millage of the tax rate, should be provided in the organization of the commission. This minimum should be such that a fair amount of maintenance work can be done when no other funds are available. Councils that appropriate money sometimes hamper boards by withholding appropriations. Work of the nature of tree planting should not be permitted to suffer or be lost by a year's neglect. The fund provided by this minimum amount should not be so large that regular additional appropriations will not be needed to carry on the work properly, as this will give a desirable point of contact of the commission or board with the ordinary channels of expressing public sentiment in the district interested. The minimum appropriation mandatory should be sufficient to prevent injury from lack of care of work already begun. A period of minimum care and attention while a board and the people or their representatives are coming to a new understanding of one another's position is not necessarily a detriment, provided a reasonable maintenance has been possible in the interim, but without such care the results are ruinous and work would better not be started than be undertaken with the possibility of such a period of neglect occurring.

It is probably desirable to assess the cost of tree planting against the adjacent property owners at a proportional cost per front foot and to provide for maintenance out of a general fund. Boulevards and other unusual developments are sometimes maintained with satisfactory results by regular assessments against the abutting properties.

After a proper governing board is provided, the securing of a competent executive is a matter of ordinary business procedure. It is usually desirable that he shall be not only a good executive but also a man with a knowledge of trees and trained in their care, so that he may be a competent adviser of the board as well as its executive.

PLANNING FOR TREES ON CITY STREETS.

With the help of one who knows trees and the local conditions to be met, the town should be studied and a suitable kind of tree selected

P18857HP

FIG. 7.—Increased attractiveness due to trees on a city street, as shown by contrasting the two sides of the thoroughfare. If trees like red oaks, American elms, or the Eucalyptus in the distance had been used, the effect on this wide street would have been comparable to figure 3. The trees in the left foreground are umbrella trees. Merced, Calif.; midsummer.

for each street or for a large portion of a street (figs. 1 and 3), and as conditions warrant the plan should be carried out as outlined. Mixed plantings of different sorts of trees (figs. 2 and 7) are not as pleasing and effective as the use of a single species for considerable distances. The use of only one or two kinds for a whole town is likely to be monotonous, and it is also undesirable because the variety most used may become subject to serious disease or insect attacks. The species and varieties of trees suitable for city planting are few enough, if all are used, so an endeavor should be made to include as many different kinds as practicable, assigning one variety for a long stretch of street unless there is a marked change in its character, in which case a change of trees would be warranted.

Where trees are already on a street, the problem of planning for the future is frequently much complicated, especially if there are several kinds in good condition. Where there is but one good kind,

gaps can be replanted with young trees of that sort. If there are poor trees of a good variety or trees of a poor or short-lived variety it would be advisable to remove these and do all the replanting at one time, so as to have the trees on the street as nearly uniform as possible. Where there are several good varieties in good condition

P14531HP

FIG. 8.—Trees 20 feet apart that should be at least 60 feet apart. Sycamores in Washington, D. C., as they appear in late winter.

the sensible thing is to care for the trees that are there and then, after careful study, decide on one variety for all future plantings on that street.

SPACING TREES.

A common fault in all street planting is to put the trees too near together. (Fig. 8.) This is more evident where the work has been done by the abutting property owners than by municipalities.

After trees are started and have attained some size it is extremely difficult to get them removed, even where the good of the remaining trees demands it. The removal of a fairly good tree merely because

it is short lived in order to make room for a good one that will be permanent does not appeal to the average citizen. Where trees which have been planted by the property holder come under city control a strong feeling of proprietorship still remains, which is outraged by the suggestion of the removal of even poor trees. Where all the work is under city control good work is often hampered by a strong public sentiment against the removal of trees, even though they are poor or crowding.

Because of this difficulty it is extremely important that young trees be planted farther apart than at that time seems reasonable. If they are planted as far apart as is proper for mature trees the distance will be so great as to make planting seem a joke. If they are planted half the distance apart they should be when mature, good results would follow if the intermediate trees were removed when they nearly touch those to be left. As the intermediate trees would probably not be removed, or not until too late for the good of the remaining ones, planting had better be sufficiently far apart in the beginning to avoid the necessity of later removals. In the beginning the trees will be too far apart and when mature too close together, but it seems to be the alternative imposed by a misguided public opinion.

There is scarcely a community that would permit the removal of interplanted trees from a street of fine elms, oaks, or other worthy varieties without a protest that would be the almost sure political death of the administrative authorities responsible, no matter how great the need or how much expert support they might have. If short-lived intermediate trees were used they would not be likely to be taken out before they died, and they probably would not die before they had irreparably injured the permanent trees. The removal of surplus or interplanted trees can be made with least shock to the community by gradually narrowing the tree tops by severe pruning from year to year on the sides next the permanent trees until finally they are so narrow they may be removed and leave only small openings between the permanent trees. Even this method will not materially lessen the public protest at the final removal.

A common practice is to set street trees 35 feet apart. If it were practicable to remove one-half the trees at the proper time this would be a good distance, but in the eastern half of the United States and on the Pacific slope 50 feet apart is close enough for most varieties, and for the larger growing trees 60 to 70 feet would be better.

CONDITIONS FOR TREE GROWTH.

In order to grow, trees must have a soil of suitable texture, in proper mechanical condition, that contains sufficient available mineral elements and plenty of organic matter, and, last but not least, a constant supply of moisture and air. In addition to these there must

be in active growth in the soil many forms of organic life that are in various ways preparing the material in the soil for the use of the larger plants. Not only must these things be present, but others that are deleterious must be absent, whether the substance is hurtful in itself or whether it is an excess of one that is otherwise beneficial.

Above the soil three things must be present—air, sunlight, and moisture—and, as in the soil, harmful things must be absent in order to have success. Among the deleterious substances are sulphur and other fumes and soot and other products from incomplete combustion.

Some of the more obvious things with which a city tree has to contend are: Water-tight pavements, both on the sidewalk and

P14533HP

FIG. 9.—The irregularity in the size of the trees shown is due to a part of the first planting having been killed by illuminating gas from defective pipes. Norway maples as seen in Washington, D. C., in late winter.

street, that prevent the admission of air and water; the removal of the topsoil in street grading, thus forcing the tree to exist on the good soil provided in the hole; careless digging near the tree for gas, water, and electric service, and especially for the placing of curbstones; the saturation of the soil with illuminating or sewer gas from defective pipes (fig. 9); the pouring of salt water from ice-cream freezers into gutters, where it may find its way into the soil near tree roots; the gnawing of the trunks by horses; and the cutting of the tops by linemen and tree trimmers.

Because of the uncongenial conditions for the growth of trees on city streets comparatively few kinds are satisfactory for such use.

Among those available are some that will grow under extremely trying conditions. Kinds can be found that will thrive wherever it is suitable for human beings to live. If it is impossible to grow trees on a street, as a health measure that street should be closed for human use until conditions are so improved that it will support trees.

More kinds will thrive under suburban conditions where only a small portion of the roadway is covered by an impervious coating, where the parking spaces are liberal, and where the street is lined with

P15298HP

FIG. 10.—A business center relieved by a parking with Carolina poplars. Macon, Ga.; late summer.

open lawns than under the conditions in a city, where the street is covered with a water and air proof coating and the sidewalks with an impervious material, where parking spaces are limited, and where adjoining lawn areas are small or lacking. By a careful selection of kinds, all conditions in a city can be met. In some places bad conditions could have been improved greatly by a little forethought; in others, such conditions can be bettered. These details, like many other matters connected with city planning, have been ignored, but should be considered immediately, especially by villages and small cities. Figure 6 shows how an opportunity for creating a beauty spot has been lost sight of, while figure 10 shows how a city has utilized less ground to increase the comfort and attractiveness of its business center.

A common mistake in ambitious young cities and many old ones is to pave more of the width of the street for traffic purposes than is

likely ever to be needed. By reducing the roadway and throwing the remainder into liberal parking spaces much is added to the attractiveness and comfort of a city. A contrast in the two methods of treatment is illustrated in figures 11 and 12. The recommendation that

P15278HP

FIG. 11.—A street well proportioned in width of roadway, sidewalk, and parkings, with willow oaks on the left, American elms on the right, and young Carolina poplars near the roadway that should be removed. Columbus, Ga.; midsummer.

P14359HP

FIG. 12.—A street with too much pavement and too little parking space. Carolina poplars in Baltimore, Md., in midautumn.

the roadway prepared for travel be made narrow is not to be interpreted as a reason for lessening the area dedicated to the public use; in fact, in most cities, especially in the northeastern quarter of the United States, too little space has been reserved from houseline to houseline (fig. 13). By reserving more room between the houses and

the street for use as lawns and gardens the conditions would be made more livable, opportunity would be offered for widening the public way without prohibitive expense if traffic or business demanded it, and the growing of street trees would cease to be a serious problem.

P16842HP

FIG. 13.—A street with too little room from houseline to houseline. Note the more attractive appearance of the side with trees. Norway and silver maples in Frederick, Md., in midsummer.

KINDS OF TREES SUITABLE FOR CITY STREETS.

QUALITIES NECESSARY.

Compared with the whole number of trees used for ornamental planting, the number of kinds suitable for street planting is very small. For use under city conditions a tree must be adapted to the climate and to the soil upon which it is to be grown. It must have healthy foliage that withstands dust and smoke and a root system not easily affected by unusual soil conditions, by restricted feeding areas, or by root pruning when street improvements are made. The top should be in proportion to the width of the street upon which it is used, and it should be rather high headed or easily trained to that form and of open growth without being too spreading or sprawling.

Of minor consideration is the character of the foliage masses, whether dark or light, heavy and somber or open and airy, and also whether they have vivid autumn colorings. Only in the most southern parts of the country and in western California should evergreen trees be considered for street planting, and then only the broad-leaved evergreens, such as magnolias and live oaks. In the North the lack of sunshine during the short cloudy days of winter makes it desirable to admit all the light possible. Even in the South the question of sunshine should be considered when selecting varieties.

Narrow streets should be planted with columnar trees (fig. 14) or sometimes with small trees. Broad streets may be planted with spreading trees (figs. 3 and 16), or, if provided with a central parking space, with moderate-sized trees in the center and on the sides, or with trees on the sides suited to the space and formal trees in the center. (Fig. 15.)

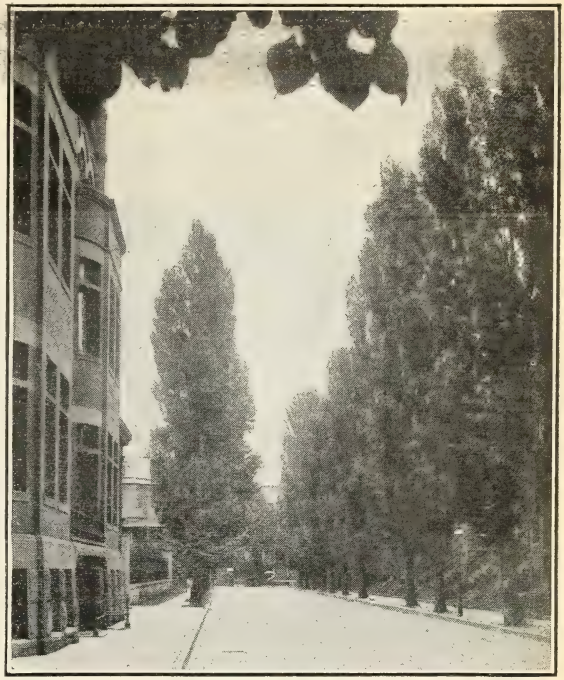


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FIG. 14.—Narrow upright trees (Lombardy poplars) on a narrow street. Washington, D. C.; midsummer.

As a rule, trees native to the locality that have been successfully grown in other cities should be given the preference. When a choice must be made between untried native trees and those tested in a city or town under different soil or climatic conditions, it is better to give the native trees the first trial. There are many native trees that are promising which have not been planted on a sufficient scale or under sufficiently varied conditions to demonstrate their real value for street planting over any considerable area. Many of the trees mentioned in this bulletin may prove valuable far beyond the areas for which they are suggested. The burr oak, the swamp white oak, the scarlet oak, the chestnut oak, the white oak, the sour gum, and others may be found on further trial to be as

P18855HP

FIG. 15.—Formal trees in a central parking, but appropriate trees wanting on the sides of the street. Canary Island date palms in Merced, Calif.; midsummer.

valuable as those already demonstrated to be valuable over large areas. Those mentioned have all been tested in a small way.

Caution should be used in selecting trees with conspicuous flowers and those with edible fruits or nuts, as in many parts of the country such trees are badly mutilated by the public. Even horse-chestnuts, although the nuts are not edible, are often broken by boys clubbing the trees. That public opinion can prevent such vandalism is in evi-

P15394HP

FIG. 16.—Live oaks, the handsomest southern street tree for broad streets. Biloxi, Miss.; late summer.

dence all along the Pacific coast and at a few places in the East. Every effort should be made to create a sentiment that will protect these attractive additions to street adornment, but where the sentiment does not exist it is better to avoid the planting of such trees except in a limited way.

Besides the native trees there are many introduced trees that have proved valuable and many more that are worthy of trial.[1] A fair trial of promising introduced trees should be made, and the native kinds should be thoroughly tested.

TREES FOR DIFFERENT REGIONS.

To simplify the discussion of kinds of street trees likely to prove satisfactory, the United States has been arbitrarily divided into the regions shown in figure 17. An endeavor has been made to make each division cover an area having similar growing conditions, so that the trees suggested will be likely to thrive in all its parts. A dis-

[1] As examples of this are a number of new elms such as *Ulmus pumila* and *Ulmus densa*, besides lindens, poplars, and *Koelreuteria paniculata*, while *Pistacia chinensis* is suitable for warm regions. The Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture will be glad at any time to suggest new trees that are promising for any region.

cussion of the strong and weak points of the different kinds will be found with the description of the kinds farther on in this bulletin.

Region 1.—Region 1 comprises the mild humid portion of the northern Pacific coast east to the Cascade Mountains, including the western third of Washington and Oregon and a portion of northern California. The trees native to western Europe are adapted to this region, as the climatic conditions are quite comparable. Most of our American trees also succeed here.

Some of the desirable varieties for street planting in region 1 are the Oregon, Norway, sycamore, and sugar maples; California walnut; tulip; European linden; basswood; sycamore; London plane; white and European ashes; English and American elms; English, red, and pin oaks; ginkgo; and the black locust.

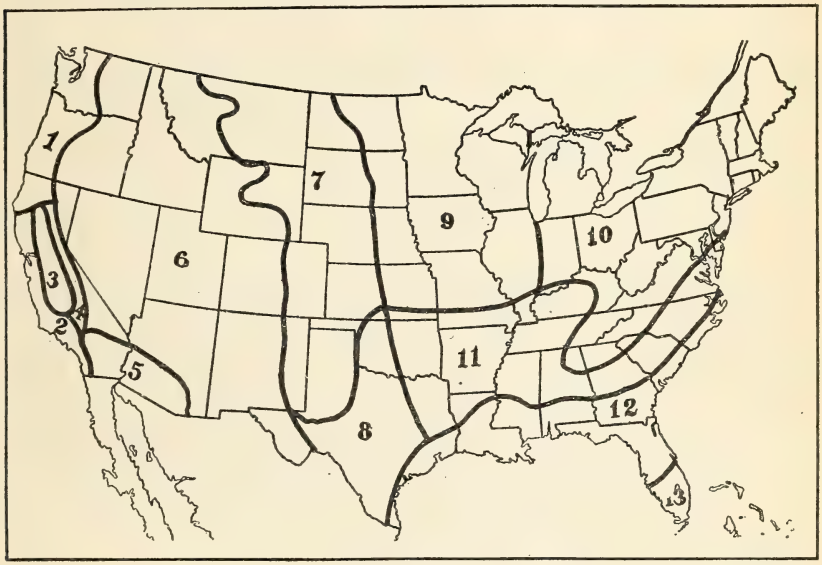

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FIG. 17.—Outline map of the United States, showing the regions within which essentially similar conditions for tree growth exist.

Region 2.—Region 2 is that portion of California lying between the Sacramento and San Joaquin Valleys and the Pacific Ocean. Many varieties of trees will succeed here if given water. Because of the lack of water, unless specially irrigated the more drought-resistant species should be used.

Among the deciduous trees useful for this region are the London plane; the California and common sycamore; English, Huntingdon, and American elms; Oregon, Norway, sycamore, and English maples; white, green, and European ashes; red, English, and pin oaks; European linden; basswood; California walnut; honey and black locusts; horse-chestnut; Albizzia; and the Japanese varnish tree, or Sterculia.

Evergreen trees which will probably be successful in region 2 are the Eucalyptus [1] in variety, acacias, rubber, magnolia, California live oak, Victorian and poplar-leaved bottle trees, and in the southern portions the California pepper, silk oak, and jacaranda. Palms are much planted, but they do not make good street trees except where a formal effect instead of shade is desired.

[1] Some cities have ordinances against the planting of certain trees because their roots sometimes obstruct sewers. Among these trees are the Eucalyptus in California and some of the poplars in several of the States.

Region 3.—Region 3 comprises the Sacramento and San Joaquin Valleys.

The deciduous trees for this region are the California walnut; London plane; California and common sycamores; Oregon, Norway, and sycamore maples; white, European, and green ashes; red, English, valley, and pin oaks; European linden; basswood; English and Huntingdon elms; honey locust; and horse-chestnut. Chinaberries and Texas umbrellas are much planted in these valleys, but are not good street trees. Olives and palms are suitable only for formal effects, while eucalypti are satisfactory but are liable to make trouble with defective sewers. Acacias grow especially well in this region except in the extreme north.

Region 4.—Region 4 includes the country from the Sacramento and San Joaquin Valleys to the crest of the Sierra Nevada Mountains. It varies in elevation and correspondingly in temperature and the amount of available moisture.

Where there is sufficient moisture, the deciduous trees recommended for region 3, except the valley oak and possibly the California sycamore, may be used. Where there is less moisture the thornless honey locust, black locust, green ash, hackberry, poplars, ash-leaved maple, and the American elm if it can be watered the first few years may be planted. In the warmer sections the chinaberry and Texas umbrella may be used.

Region 5.—Region 5 comprises the hot semiarid country of southern California and southwestern Arizona which is dependent on irrigation.

The best deciduous trees for this region are those suggested for the drier portions of region 4. With ample irrigation the deciduous trees recommended for region 3 might grow.

Among the evergreens the Texas palmetto, Parkinsonia, and the Washingtonia and some other palms can be used where other trees do not succeed. The red and desert gums may be used also in the drier regions. With ample irrigation the evergreens suggested for region 2 should succeed.

Region 6.—Region 6 comprises the intermountain section and extends from the crest of the Cascade and Sierra Nevada Mountains eastward to the eastern base of the Rocky Mountains. The region includes great variations in growing conditions, often in very short distances. As a whole it is semiarid, and in most places trees can hardly be expected to thrive without more or less irrigation, although in some of the mountain valleys and on some of the mountain slopes almost ideal conditions for tree growth exist.

In the drier parts of the region only those deciduous trees that are weeds under more congenial conditions can be grown. Those that can be planted with the greatest hope of success are the thornless honey locust, black locust, green ash, hackberry, and where the others do not succeed, the poplars and ash-leaved maple. If it can be watered for a few years the American elm usually can be grown, and in the southern half of the region the Mississippi hackberry will probably succeed. Near the southern border, on lower elevations, the chinaberry and Texas umbrella can also be planted. In the locations most favored naturally or where irrigation is possible, the trees suggested for region 9 can be used.

Evergreens that may be used for the drier portions of the southern part of region 6 are the Parkinsonia and the Texas palmetto.

Native trees may be found that will prove of greater value for limited areas than any suggested. Cities and towns contemplating street tree planting would do well to consult the nearest State agricultural experiment station or the United States Department of Agriculture if it is thought possible that something better has been found than the trees suggested.

Region 7.—Region 7 is the northern part of the Great Plains area from the foot of the Rocky Mountains at about the 5,000-foot contour line east to the ninety-eighth meridian. It is rather uniform in general conditions, the character of soil having no wide divergence and the elevation increasing gradually from south to north and east to west.

The rainfall gradually increases from west to east until at about the ninety-eighth meridian the conditions are more favorable for tree growth.

The trees to be relied on are the thornless honey locust, common hackberry, black locust, green ash, ash-leaved maple, the poplars, the Chinese elm, and the American elm if it can be watered the first few years after transplanting. The mossy-cup oak is another tree worth testing in a small way, as it is native a little east of the ninety-eighth meridian. The basswood and Norway maple would probably succeed if supplied with plenty of water.

Region 8.—Region 8 is the southern part of the Great Plains.

In addition to the deciduous trees recommended for the northern Great Plains (region 7) the Mississippi hackberry, Texas umbrella, and chinaberry may be successfully grown.

Evergreen trees that may be used in region 8 are the Texas palmetto and Parkinsonia.

Region 9.—Region 9 is the upper Mississippi Valley, including the area from that already considered to Lake Michigan and south to southern Kansas. It is more favorable to tree growth than regions 6 and 7.

Trees which will succeed here are the American elm; red, pin, mossy-cup, and other native oaks; white ash; sycamore; basswood; and Norway and sugar maples.

Region 10.—Region 10 includes the northeastern part of the country from eastern Illinois to the Atlantic Ocean, and extends southward through the Appalachian Mountains. It is most favorable for tree growth.

The best trees for street planting in region 10 are the red and pin oaks, London plane, sycamore, the staminate form of the ginkgo, basswood, tulip, Norway maple, white ash, thornless honey locust, American elm, and in the southern portion of the region on light land the sweet gum. The red and sugar maples are among the best trees for suburban conditions. The hackberry will grow, but should be discarded in favor of better varieties. The mossy-cup and chestnut oaks are worthy of trial on gravelly soils in the suburbs.

Region 11.—Region 11 includes the lower Mississippi Valley and the country east of the southern Appalachian Mountains, extending from the light lands near the South Atlantic and Gulf coasts to the northern limits of the distinctively southern flora.

The typical street trees of this region are the willow oaks (fig. 1) and water oaks, the former a valuable street tree, the latter good when young but comparatively short lived, with no advantages over the willow oak. Other good trees are the red, Spanish, laurel, Darlington, and pin oaks, tulip, sweet gum, American elm, red and Norway maples, and the ginkgo.

Region 12.—Region 12 is the land near the coast from Wilmington, N. C., to the Mexican border, exclusive of the southern part of Florida.

Good deciduous trees for this region are the willow, laurel, Darlington, and Spanish oaks, tulip, sweet gum, sycamore, London plane, American elm, and the staminate form of the ginkgo. The honey locust, red or scarlet maple, Norway maple, and the hackberries are not so good.

The live oak is the characteristic tree of region 12 (fig. 16) and is the pride of the cities that have used it. Even though an evergreen, it is an excellent street tree, as it is large, spreading, and open. The palmetto and palms thrive and may be used for producing formal effects. The evergreen magnolia is a good broad-leaved evergreen.

Region 13.—Region 13 consists of the southern part of Florida. The deciduous trees suitable for this section are the willow, Spanish, and southern red oaks; American elm; Mississippi hackberry; and in the southern half of the region the Poinciana.

Evergreen trees are better suited to region 13 than to any other portion of the United States except possibly southern California. Among the best are the live and

laurel oaks, evergreen magnolia, camphor, rubber, silk oak, or grevillea, and casuarina. Eucalypti are planted to some extent in Florida, but the climate is such that only on the drier grounds of the interior are they likely to succeed, and even there they are not to be compared with other excellent species of trees that may be cultivated successfully.

TREES FOR SPECIAL PURPOSES.

In the heart of a city, where the greatest difficulty is experienced in getting trees to grow, the ailanthus will probably thrive when nearly all other kinds fail. The sycamore and the London plane are also good for such places. The Carolina poplar will frequently grow under these conditions, and its use may sometimes be warranted.

For very narrow streets the Lombardy poplar is the best tree. (Fig. 14.) Trees suitable for use within the reach of ocean spray or on sandy lands near the coast are the red oak and the red or scarlet maple south to Charleston, S. C., while the sweet gum and the live oak are equally good from Norfolk southward and along the Gulf of Mexico. The red oak, sweet gum, red maple, and eastern live oak are all grown successfully along the Pacific Ocean, while the California live oak can be used from San Francisco southward. The trees that endure the most alkali appear to be the bladder-nut tree,[1] London plane, peppermint gum,[2] blue gum,[3] the Washingtonia and other hardy fan palms, Canary Island date palm, the camphor tree, and *Acacia cyclops* and *Acacia retinodes*. Only the first two withstand severe freezing weather. The red oak and the red maple are worth testing for these conditions.

DESCRIPTIONS OF STREET TREES.

ACACIA.

The acacias, or wattles, are a large group mostly of small trees with showy yellow flowers. Although much used in California, many of them are too small to make satisfactory shade trees, and because of shallow rooting they are injurious to sidewalks. They also stump-sprout badly. They thrive in regions 2 and 3 and in restricted portions of regions 1 and 5.

The Australian blackwood,[4] blackwood acacia, or wattle, is a strong, upright tree, growing to a height of 75 feet and forming a well-shaped head. It is badly affected by citrus scale, and on this account its planting is sometimes prohibited.

The black wattle[5] is a strong-growing round-headed tree that reaches a height of 40 feet and has dark-green leaves.

The green wattle[6] is a rapid-growing tree, reaching a height of 60 feet and forming a round head with finely cut leaves.

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[1] *Koelreuteria paniculata.*
[2] *Eucalyptus amygdalina* Labill.
[3] *Eucalyptus amygdalina angustifolia.*
[4] *Acacia melanoxylon* R. Br.
[5] *Acacia decurrens mollis* Lindl.
[6] *Acacia decurrens* Willd.

The silver wattle [1] is much like the black wattle except that its leaves and young branches are covered with a whitish down.

AILANTHUS.

The ailanthus,[2] or tree of heaven, is a tall, broad, handsome tree that is especially valuable in the heart of closely built or smoky cities. The staminate and pistillate flowers are borne on separate trees. Only the pistillate trees should be used, as the odor of the blossoms of the staminate ones is very objectionable for about 10 days in late spring. These may be produced by grafting from pistillate trees or by propagating from suckers or root cuttings from such trees if they have not been grafted. The ailanthus may not succeed in regions 5 and 13.

ASH.

There are three kinds of ash trees that are useful for street planting.

The white ash [3] is a large oval-headed tree, reasonably satisfactory on rich lands in regions 1, 2, 3, 4, 9, 10, 11, and 12, but it is better adapted to suburban than urban conditions.

The green ash [4] is one of the few successful trees in regions 6, 7, and 8 and may succeed in region 5. It grows well throughout the remainder of the United States, but is of less value than other trees there. It is much smaller than the white ash, with a broad round top.

The European ash [5] is a large, handsome, round-headed tree suited to regions 1, 2, 3, and 4.

CAMPHOR.

The camphor tree [6] is a large, handsome, oval-headed evergreen that will succeed in the southern half of region 2, in regions 3, 5, and 13, and in the warmer parts of region 12. It will endure more frost than the orange, and where it is successfully grown it is deservedly popular.

CHINABERRY.

The chinaberry,[7] sometimes known as the China tree, is a small, round-headed, short-lived tree that will grow in regions 2, 3, 5, 8, 11, 12, and 13 and near the southern edge of region 6. It is too short lived to be considered for planting where other trees will grow

The umbrella tree,[8] or Texas umbrella, is a small, compact form of the chinaberry with an umbrella-shaped top. It is useful for formal effects, as in the parking on a wide street where taller trees are used on the side. It will grow in regions 2, 3, 5, 8, 11, 12, and 13 and in the southern parts of region 6.

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[1] *Acacia decurrens dealbata* F. Muell.

[2] *Ailanthus altissima* (Mill.) Swingle (*A. glandulosa* Desf.).

[3] *Fraxinus americana* L.

[4] *Fraxinus lanceolata* Borck.

[5] *Fraxinus excelsior* L.

[6] *Cinnamomum camphora* (L.) Nees and Eberm.

[7] *Melia azedarach* L.

[8] *Melia azedarach umbraculiformis* Berckmans and Bailey.

ELM.

The elms are large, handsome shade trees suitable for use over a wide range of territory.

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FIG. 18.—An American elm with crotches liable to be split by heavy winds. Note the supporting chains.

The American elm,[1] sometimes called the white elm and water elm, is one of the handsomest American shade trees. (Fig. 3.) It has

[1] *Ulmus americana* L

been the standard street tree of New England, giving to the roadsides and village streets the characteristic appearance which is so attractive to summer visitors.

The American elm is tall and spreading, and where planted as near together as is customary on streets and country roads the effect of the mature trees is that of an arch formed by the growing together of their spreading tops. It is of rapid growth and long lived.

This elm drops its leaves very early in the fall, but it comes into leaf early in the spring. Because of its manner of branching it is especially liable to be split by heavy winds. This trouble may be lessened by selecting and planting specimens with a close, compact habit of growth or possibly also by great care in training young trees. Two limbs separating from one another by a very small angle, that is, when they start to grow in nearly the same direction, make a crotch that is liable to split. (Fig. 18.) Where two limbs separate at nearly a right angle or where three or more limbs of about equal size grow from a common point or very nearly so, the crotch is likely to be much stronger. Careful pruning and training to provide a proper system of branches may be especially helpful with this elm.

Because of the attacks of the elm leaf-beetle [1] and the European elm bark louse,[2] many handsome trees have been severely damaged or killed before communities were properly equipped for fighting them, for with careful spraying these insects may be kept in check. However, on account of the existence of these pests and because they are gradually spreading to new territory, tree planters should consider carefully whether it is advisable to plant the elm in their localities. Where there is no danger from these insects, this elm is one of the best of street trees. Consultation with the nearest State agricultural experiment station or with the Entomologist of the United States Department of Agriculture would be advisable in order to determine this point.

The best specimens are to be found in the northern part of region 10, although the elm is being grown all over the United States and is proving a valuable street tree even in towns and villages of regions where the rainfall is as low as 15 inches. It is not recommended for planting in regions 3 and 5.

The English elm [3] is a tall, oval-headed, compact, handsome tree with leaves smaller than the American elm and which stay on much later in the fall. In regions 1 and 2 it is at its best, in the former equaling the American elm and in the latter excelling it. It also thrives in regions 3 and 10 and in the eastern part of region 11.

The Huntingdon elm [4] is a comparatively round-headed European variety.

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[1] *Galerucella luteola* Müll.

[2] *Gossyparia spuria* Mod. (Data regarding both insects furnished by the Bureau of Entomology.)

[3] *Ulmus campestris* L.

[4] *Ulmus hollandica vegeta* (Lindl.) Rehd.

It is a large, handsome tree with good foliage and is more compact in growth than the American elm. It succeeds well in regions 1, 2, 3, and 4.

The wahoo, or winged elm,[1] is native to the South Atlantic and Gulf States near the ocean. It has larger leaves than the American elm and is not as spreading in its growth, but it succeeds well on city streets in regions 11, 12, and 13.

EUCALYPTUS.

There are a large number of species of Eucalyptus, many of which can be used for street planting in regions 2, 3, and 5. Some cities prohibit their planting because their roots are liable to penetrate defective sewers, and in other cities they must be kept at least 70 feet from a sewer, though even this distance may not prove permanently effective.

The roots of any tree are liable to find their way into a defective sewer, but the trees mentioned are especially noticeable because of their vigorous root growth. It may be questioned whether a tree should be condemned for this growth, as it may be better to have a defective sewer thus revealed than to continue a menace to public health.

Eucalypti are also being planted in southern Florida, but on account of the moist climate there it is not to be expected that they will succeed as well as in the other regions mentioned. They are tall, handsome, quick-growing trees, usually bearing two kinds of leaves at some time in their development.

The blue gum[2] is one of the best eucalypti and the one most commonly used in California. It is tall, globular headed, handsome, and will survive several degrees of frost, but it will not withstand the heat of the deserts in region 5. Its roots are especially liable to invade sewers.

The desert gum[3] is one of the trees most resistant to heat and cold, and it makes a handsome avenue tree. It has pendent branches that have a tendency to severe splitting with age, but with early attention this may be overcome largely. It may prove especially valuable for region 5.

The manna gum[4] is another Eucalyptus which withstands several degrees of frost and makes an excellent roadside tree. Some forms shed their bark in long bands that leave the trunks almost white. Many people consider it a dirty tree on this account.

The red gum[5] grows with a broad head, is one of the most resistant of the eucalypti to frost, drought, and heat, and succeeds wherever any of these trees can be grown in regions 2, 3, or 5, but is most useful in region 5.

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[1] *Ulmus alata* Michx.
[2] *Eucalyptus globulus* Labill.
[3] *Eucalyptus rudis* Endl.
[4] *Eucalyptus viminalis* Labill.
[5] *Eucalyptus longirostris* F. Muell.

The sugar gum[1] is a drought-resistant variety, but it does not withstand cold. It is a common roadside tree in southern California, but becomes straggling with age.

GINKGO.

The ginkgo,[2] or maidenhair tree (fig. 4, *B*), is a native of Japan that thrives in a cool climate or a hot, moist one and succeeds in regions 1, 9, 10, 11, 12, and 13. It is extremely erratic in its behavior, sometimes growing well, sometimes practically not growing at all, but where it succeeds it is very disease resistant, and it withstands severe windstorms remarkably well. The leaf is peculiar in appearance, resembling in outline a much enlarged leaflet of maidenhair fern with a corrugated surface. The tree is conical when young, but as it reaches maturity its top usually fills out, making a broad, almost flat-topped, handsome tree. Only the staminate form should be used, because the pistillate form bears fruits the flesh of which is slippery and dangerous when it drops to the pavement, and to some people it is somewhat poisonous to the touch. Ginkgo trees, therefore, would need to be secured by budding or grafting from the mature staminate form.

HACKBERRIES.

The hackberry,[3] or sugarberry, is especially valuable in regions 6, 7, 8, and 9, as it grows satisfactorily where there is comparatively slight rainfall. It is also much used in region 11, but should be superseded there by other varieties that are better. It is of moderate size with an oblong head and of rather open growth. It is comparatively short lived. Its leaves are much like those of the elm.

The name sugarberry comes from the sweet black berries that are borne in the early fall. The tree is sometimes affected by a fungous trouble known as witches'-broom. This trouble causes large numbers of small sprouts to start from the affected portion, which gives the infected tree an unsightly appearance. The hackberry should not be planted where this trouble is prevalent.

The Mississippi hackberry[4] is a large, open, oblong-headed tree with smoother leaves than the common hackberry. It is useful in the southern part of region 6, in region 8, and to some extent in regions 11 and 12. It thrives well under the same adverse moisture conditions as the common hackberry. The trunk and the large branches have little wartlike projections of the bark scattered irregularly over them. The small twigs are sometimes more or less spotted or winged in the same way. The tree is rather larger than the common hackberry and apparently is less subject to witches'-broom.

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[1] *Eucalyptus corynocalyx* F. Muell.
[2] *Ginkgo biloba* L.
[3] *Celtis occidentalis* L.
[4] *Celtis mississippiensis* Bosc.

HONEY LOCUST.

The honey locust[1] is a large, open, round-headed, fine-foliaged tree, admitting much light through its top. (Fig. 19.) The common form has stiff spines 2 to 6 inches long, or even longer. There is also a form without spines, which is the one that should be used for street planting. It is a useful tree in regions 1, 2, 3, 9, 10, and 11, but is especially valuable for planting in regions 6, 7, and 8, and may prove useful in region 5.

FIG. 19.—A street shaded with honey locusts, as seen in late summer. Washington, D. C.

HORSE-CHESTNUT.

The horse-chestnut[2] has handsome blossoms that are very showy, and when in bloom an avenue of these trees commands attention. It is a close relative of the buckeye, or Ohio buckeye, which is also a handsome tree, though less desirable. It is objectionable because it is likely to be broken by boys clubbing it for its nuts, which are inedible, or where its leaves are affected with a midsummer blight which makes it unsightly during the remainder of the season. It is a medium-sized round-headed tree that does much better under surburban than under city conditions. It thrives in regions 1, 2, 3, and 10.

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[1] *Gleditsia triacanthos* L.

[2] *Aesculus hippocastanum* L.

LINDEN.

The basswood,[1] or linden, is a large round-headed tree that is excellent for roadsides in surburban locations and does well on city streets if the conditions are not too severe. On account of the dark upper surface and the lighter under surface of the leaves and the sweet-scented blossoms in early summer it is much admired. It is not as reliable as some of the other shade trees, as when young it is sometimes attacked at the base of the trunk by a fungous growth that kills the tree. When once established it forms handsome avenues. It is suited to regions 1, 2, 3, 4, 7, 9, 10, and 11.

The linden,[2] or European linden, has much smaller leaves than the American linden, or basswood, with more contrast between their upper and lower surfaces. It is not much different in size, but is a little more compact in growth and holds its leaves longer in the fall. It is a useful tree for street planting in regions 1, 2, 3, 4, 9, 10, and 11.

LOCUST.

The locust,[3] or black locust, is one of the desirable street trees in regions 6, 7, 8, and probably in region 5, as it thrives with comparatively little moisture. It makes a moderate-sized oval head that bears sweet-scented white flowers in late spring or early summer. Its greatest drawback is its liability to serious injury and disfigurement by the locust borer,[4] but with proper care this injury can be prevented.[5] In some parts of the East it is also subject to a leaf miner [6] that gives its foliage a burned appearance. In region 3 it holds its seed pods for several years and thus becomes very unsightly.

MAGNOLIA.

The evergreen magnolia [7] is one of the few good evergreen trees for street planting, but it is adapted only to regions 1, 2, 3, 11, 12, and 13. There are but few conditions that warrant the planting of a tree having foliage as thick as this, because of the dense shade, which is especially undesirable in winter. It grows to be a large oval-headed tree and bears beautiful large white blossoms in late spring or early summer.

MAPLE.

Among the maples are some undesirable trees much used for street planting and some that are valuable only in restricted areas or under special conditions. The maples are not as satisfactory for

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[1] *Tilia americana* L.

[2] *Tilia platyphyllos* Scop.

[3] *Robinia pseudacacia* L.

[4] *Cylene robiniae* Forst. (Data furnished by the Bureau of Entomology).

[5] See U. S. Dept. of Agriculture Bulletin 787, entitled "Protection from the Locust Borer."

[6] *Chalepis dorsalis* Thunb.

[7] *Magnolia grandiflora* L.

street planting as usually has been supposed, few of the species being suitable for this purpose and these only in a limited way.

The ash-leaved maple, or box elder,[1] is native to all of the country east of the Rocky Mountains except the regions near the South Atlantic and Gulf coasts. It is a small, quick-growing tree that will thrive almost anywhere, but it reaches maturity early. Because of its early decay and of its being subject to destruction by wind, it should not be used for street planting where other trees succeed. It would be a good tree for interplanting were it safe to risk taking out some of the trees at the right time. The objection to using these trees is that they would be so likely to look larger and better than the permanent trees at the time they should be removed that public opinion would probably resent their removal. There may be conditions requiring the use of this tree in regions 6, 7, and 8, but it should be grown only when the other trees suggested for these regions will not succeed.

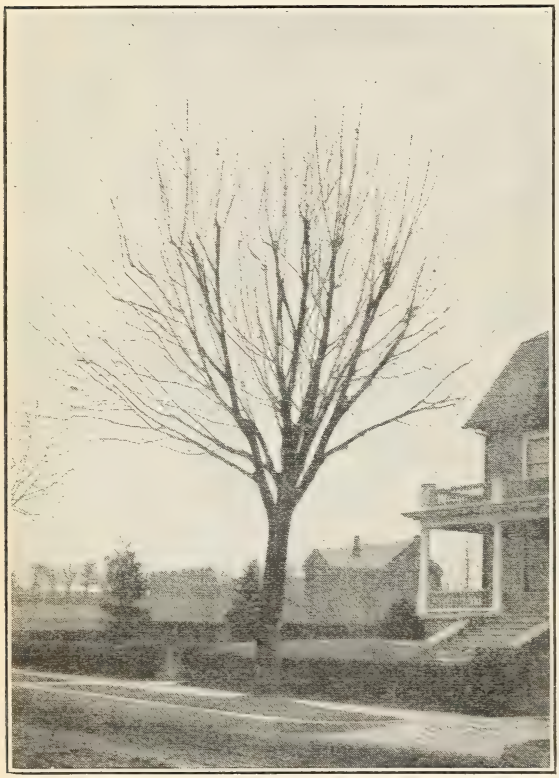

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FIG. 20.—A Norway maple, as seen in late winter, showing its poor shape when trimmed to a high head.

The English maple[2] is small, round headed, with small dark-green leaves, useful in regions 1, 2, 3, and 4.

The Norway maple[3] is round headed and eventually reaches large size, but, as compared with most of the other maples, it is slow growing (fig. 4, *C*). The persistence of its tendency to form a low head makes it difficult to give it a high head of desirable shape (fig. 20). It is also very thickly branched, and its foliage, being heavy and dark green, permits but little light to pass through. On this account it is rather undesirable for street planting. By severe pruning of the interior of the head this defect may be somewhat

[1] *Acer negundo* L. [2] *Acer campestre* L. [3] *Acer platanoides* L.

overcome. The tree is practically disease and insect free, with the exception of a liability to infestation by a leaf aphis[1] which produces yellow spots on the leaves and causes them to drop prematurely; also, the honeydew which they produce is so abundant at times as to cover the leaves and wet the sidewalk beneath the tree, the leaves under certain weather conditions becoming blackened with dust accumulating and a fungus growing in the secretion, thereby giving the tree an unsightly appearance. This aphis, however, is not always present and does not seriously injure the tree. The Norway maple comes into leaf later than most of the other maples, but holds its leaves later in the fall. They usually assume a bright yellow hue before they drop. The leaves are preceded by an abundance of yellow-green blossoms. On account of its dense shade and masses of fine fibrous roots it is difficult to grow grass under this tree. Its good shape and attractive dark-green foliage make it popular for street planting in spite of its dense, low head. It will succeed in regions 1, 2, 3, 4, 9, 10, 11, and 12.

The Oregon maple[2] is the large-leaved maple of the northern Pacific slope. It forms a large round head, and with its unusually large dark-green leaves makes a very attractive street tree that succeeds well in regions 1, 2, 3, and 4. It is valuable and worthy of more extended cultivation on the Pacific coast.

The red maple,[3] scarlet maple, or swamp maple is one of the most widely distributed of American trees. It is found from Canada to the Gulf of Mexico and west to the Rocky Mountains. Its leaves are the smallest of any of the eastern native maples, but it grows large and the trees are usually of rather upright outline. It is better adapted to suburban conditions than to city streets and is one of the few trees that succeed well near the ocean. It has bright-red blossoms before the leaves appear. The young leaves and fruits are also red. The mature leaves begin to color early, some branches coloring as early as the middle of July, assuming brilliant reds and yellows and staying on later than those of the sugar maple. It is a handsome tree that is not as much used as it deserves to be in regions 1, 9, 10, 11, 12, and 13.

The silver maple,[4] also called the soft maple, white maple, and swamp maple, is probably more used for street planting through the whole United States than any other tree, and with one exception it is the least desirable. It is usually planted because it is a quick-growing tree, but it is not more rapid in growth than several other much better trees. There are three serious objections to its use as a street tree. The first is its brittle wood, which at an early

[1] *Periphyllus lyropictus* Kess. (Data furnished by the Bureau of Entomology.)
[2] *Acer macrophyllum* Pursh.
[3] *Acer rubrum* L.
[4] *Acer saccharinum* L.

age is easily broken by ordinary windstorms and causes it when a comparatively young tree to become unsightly. The second is its shallow rooting, which has a tendency to destroy pavements and also makes it difficult to grow grass near the trees. The roots also will grow into sewers. The third is the tendency to decay; the tips of the limbs frequently die, leaving the whole top of the tree bare of leaves, and the wood decays quickly, especially if the bark is broken. For this reason it does not stand pruning as well as most other street trees, and it probably has been pruned more ruthlessly than any other tree, unless it is the Carolina poplar. It should never be severely deheaded or, as it is popularly called, "dehorned" (fig. 21), as the stubs will practically never heal over, and from these cuts decay will start, which in a very few years will rot the center of the limbs and trunk and thus destroy the tree. Although it forms a large round head with an open top and its foliage is pale green above and almost white beneath, making a very delightful shade, on account of its weaknesses it should never be used for street planting where other trees can be made to grow.

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FIG. 21.—Silver maples severely headed back, an improper way to treat trees, especially silver maples, except under very unusual conditions. Washington, D. C.; midsummer.

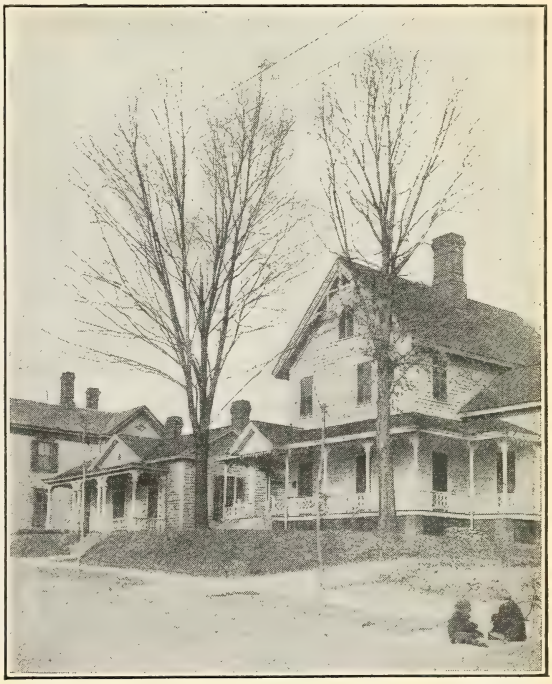
The sugar maple,[1] or hard maple, is especially adapted to gravelly soils in regions 1, 10, and 11, the northern parts of regions 2 and 3, and the eastern and southern parts of region 9. It is oval headed, large, and handsome, having red blossoms which individually are inconspicuous but which in mass are showy early in the spring before the leaves appear. The leaves come early, but in late summer they begin to turn brilliant yellow and red and drop before most other leaves. The sugar maple does not thrive under city conditions, but is admirably adapted to suburban conditions.

[1] *Acer saccharum* Marsh.

Although the sycamore maple [1] is similar in appearance to the Norway maple, it is not a satisfactory street tree in the eastern United States. It succeeds, however, in regions 1, 2, 3, and 4.

OAK.

Of the trees used for street planting the oaks are best. They probably have not been more widely planted because of the prevalent belief that they are slow growers and because in the North they are rather difficult to transplant. Although some of the handsomest species, like the white oak and live oak, are slow growers, those suitable for street planting are comparatively rapid growing. The white oak and sugar maple shown in figure 22 are each 32 years old and although differing in shape are practically the same size, yet the sugar maple is considered a sufficiently rapid growing tree to be planted frequently as a street tree, while the white oak is seldom so used. The oaks are hardy, most of them are long lived, and for the most part they are free from disease and insect attacks. Some of the southern species are subject to attacks of mistletoe.



P15662HP

FIG. 22.—A sugar maple (on the left) and a white oak (on the right), each 32 years old and nearly the same size.

The California live oak [2] is an evergreen suitable for use in region 2 and succeeds adjacent to the ocean. It is also useful in region 3 and in the western part of region 5. It is easily transplanted if handled young, and especially so when planted from pots.

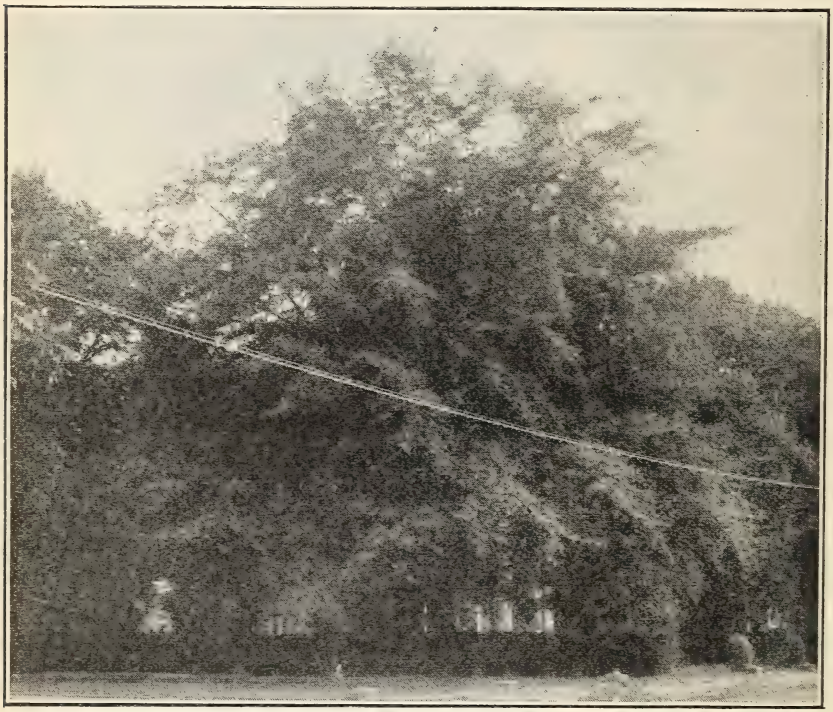
The chestnut oak [3] is a native of gravelly soils on eastern mountains and is suitable for gravelly soils in suburban locations in regions 9, 10, and 11. It is a large, handsome tree.

The Darlington oak [4] is a form of laurel oak especially desirable for street planting. It is large, round headed; the leaves are a trifle

[1] *Acer pseudoplatanus* L.
[2] *Quercus agrifolia* Nee.
[3] *Quercus montana* Willd. (formerly *Q. prinus*).
[4] *Quercus laurifolia* Michx.

smaller and not quite so nearly evergreen as the laurel oak. It is found wild about Darlington, S. C., where a good form of the laurel oak appears to have been introduced as a shade tree in the early part of the nineteenth century. (Fig. 23.) Its range of usefulness lies in regions 11 and 12.

The laurel oak [1] is a large, oval-headed tree that is not as rugged and irregular as the live oak, but is suitable for street planting in regions 11, 12, and 13. It has large, thick, glossy leaves, and in the warmer regions it is almost evergreen. It is readily trans-



P15461HP

FIG. 23.—A Darlington oak as seen in late summer, Darlington, S. C.

planted, but as it is not so common in the woods as the willow oak and the water oak, it has not been so much used as a street tree.

The live oak [2] (fig. 16) is probably the noblest and most majestic of the oaks of regions 12 and 13. It is evergreen and of slow growth, but wherever it is found, whether on streets or in public parks, it is the pride of the people. Although an evergreen it is sufficiently open headed to make a good street tree. When it becomes old it is spreading and as a rule does not form as high a head as the willow oak and the laurel oak. Compared with other southern oaks it is difficult to transplant. It is of sufficient merit to be used on broad

[1] *Quercus laurifolia* Michx.

[2] *Quercus virginiana* Mill.

streets, and especially on boulevards, where the good of the future as well as the present is considered.

The burr oak,[1] or mossy-cup oak, is native in the northeastern United States and west of the Mississippi River on the hills lying between the river bottoms and the prairies west to the western parts of the Dakotas and Nebraska and central Kansas and Texas. It is a large, handsome tree that should prove satisfactory under suburban conditions in regions 7, 8, 9, 10, and 11 and on fertile well-watered soils.

The pin oak,[2] sometimes called the swamp oak, is a tall tree, conical when young, oval at maturity, with a drooping habit of the lower branches. The leaves are quite finely divided and are of a bright

P14413HP

FIG. 24.—A street shaded with red oaks, Washington, D. C.; midsummer.

glossy green. The tree comes into leaf late in the spring and holds its foliage late in the fall. One objection to the pin oak for street planting is that on many specimens the dead leaves hang on through the winter. It is adapted to narrower streets than the red oak, as its habit of growth is not so spreading. On account of the tendency of the limbs to droop, particularly as they get older, it is desirable that a good strong leader should be developed, so that the lower limbs may be removed from time to time as conditions require. The pin oak thrives on wet and on heavy clay soils, as well as on a wide range of other soils. Figure 4 shows pin oaks, Norway maples, and ginkgos 18 years old on adjacent streets, and illustrates the rapid growth of this oak. At the time of planting these trees the pin oaks were thought to have the poorest location. This tree is adapted to regions 1, 2, 3, 4, 9, 10, and 11.

[1] *Quercus macrocarpa* Michx.

[2] *Quercus palustris* L.

The red oak[1] (fig. 24) is probably the best tree for street planting in regions 1, 9, 10, and 11 and is satisfactory in regions 6, 7, 8, and 12. It is a large, oval, open-headed tree of rapid growth. Under good conditions a young red oak will grow 4 feet in a single season. Like the other oaks it is slow in coming into leaf in the spring, but holds its foliage late in the fall. The leaves usually turn a brilliant red before they drop. It is comparatively free from insect and fungous attacks, and it is one of the few trees really suitable for planting close to the ocean, as it thrives on sandy lands only a few feet above high tide or within the reach of ocean spray.

The scarlet oak[2] is a large, open, round-headed tree. Its leaves are more deeply divided than those of the red oak. As its name indicates, the leaves turn a brilliant scarlet in autumn, being even more gorgeous than the red oak. This tree is adapted for street planting and is especially desirable for suburban conditions in regions 1, 9, and 10.

The swamp Spanish oak[3] is adapted to regions 11, 12, and 13. It belongs to the red-oak group, but is larger than the other oaks suggested for street planting. It is well adapted to suburban locations, but apparently it has not been tested under severe city conditions.

The valley oak[4] is a beautiful tree for regions 2 and 3 and the more favorable parts of region 5. When transplanted young, especially if taken from a pot, it is easily established where there is opportunity to water it for a few years.

The water oak[5] is frequently confused with the willow oak and the laurel oak, as these three oaks are not distinguished from one another except by close observers of trees. It is probably more used than any other tree in the cities of region 12 and the adjoining portions of region 11. It is the weed of the southern oaks and one of the weeds of the street trees of the Southern States. It is comparatively short lived and seems to be more subject to attacks of mistletoe and more easily affected by windstorms than the willow oak, the Darlington oak, and the laurel oak. The planting of this tree should be avoided, because it is less desirable than the other oaks mentioned.

The willow oak[6] (fig. 1), sometimes erroneously called the water oak, is one of the best of the quick-growing oaks for use in regions 11 and 12. It is frequently used with the water oak for street planting and in the mind of the average planter is confused with it. It is, however, a distinct tree, which can be distinguished readily from the

[1] *Quercus maxima* (March.) Ashe (formerly *Q. rubra*).

[2] *Quercus coccinea* Muench.

[3] *Quercus rubra* L. (formerly *Q. falcata*, and certain forms separated by some botanists as *Q. pagodaefolia* Ashe).

[4] *Quercus lobata* Nee.

[5] *Quercus nigra* L.

[6] *Quercus phellos* L.

water oak. It is longer lived and is its equal in every other respect. Trees of this variety which apparently have been planted about 80 years are found in excellent condition, while water oaks planted at the same time have either entirely disappeared or are showing

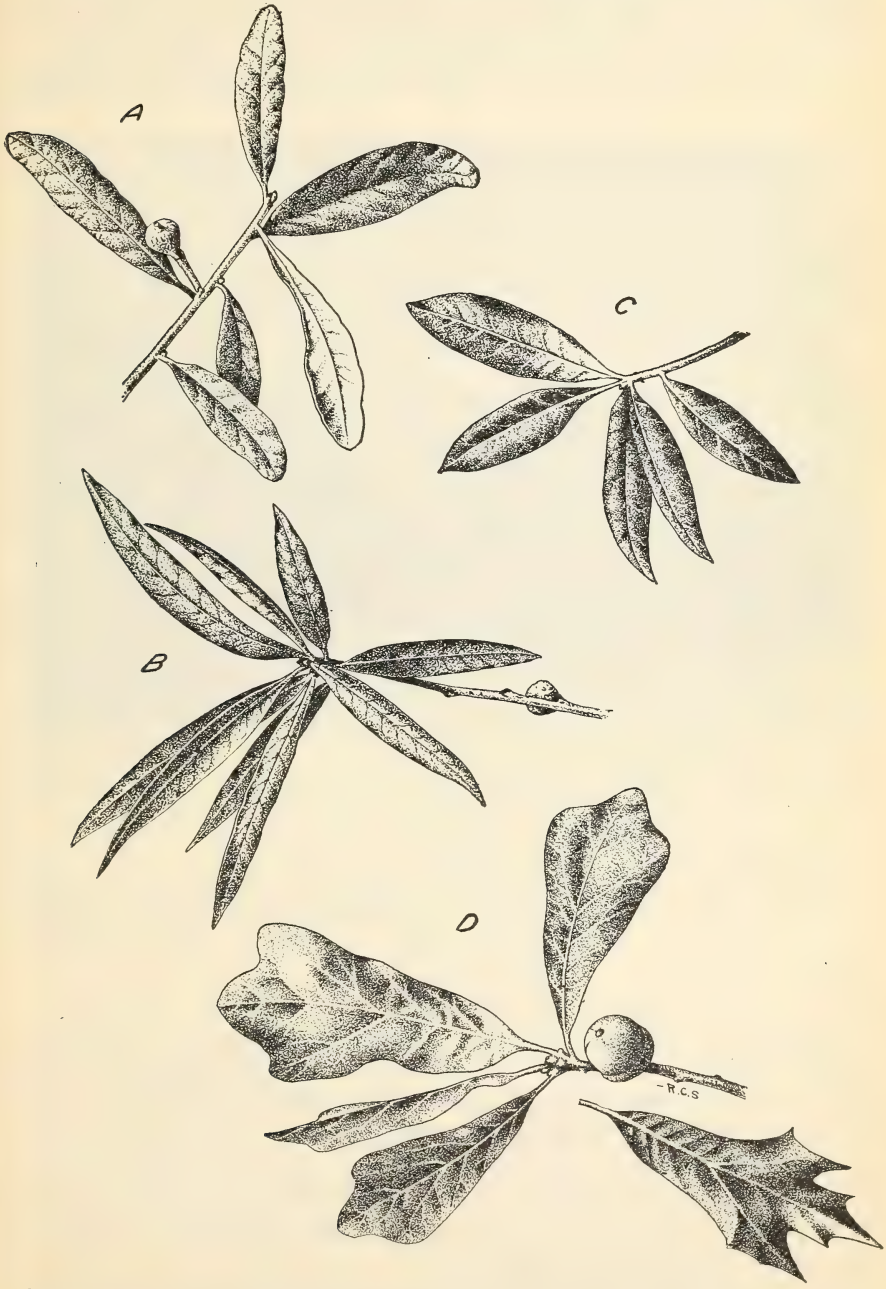


FIG. 25.—Leaves of some of the southern oaks; *A*, Live oak; *B*, willow oak; *C*, laurel oak; and *D*, water oak.

marked evidences of decline. Figure 25 shows the characteristic appearance of the leaves of these nearly related species of oaks. That the willow oak is readily transplanted in the South when of comparatively large size is proved by the success with which trees 12 feet high are dug from the woods and planted on the street (fig. 26). In the extreme South this tree is nearly half evergreen. Its foliage does not assume the bright colors of the trees of the red-oak class.

P15321HP

FIG. 26.—Recently transplanted willow oaks, showing trees taken from the woods as they appeared near the end of the second summer. Montgomery, Ala.

PALM.[1]

Several varieties of palms are used more or less for street planting in regions 2, 3, 5, 12, and 13. Though sometimes effective as a formal street decoration (fig. 27), they can hardly be considered shade trees.

PALMETTO.

Palmettos, or sabals, abound in region 12 near the coast; succeed in regions 3, 5, and 13; live in region 2; but are seldom grown satisfactorily close to the Pacific coast. They can be used effectively for formal plantings along some streets, park drives, or in liberal central parking spaces in boulevards, but they are not useful as a substitute for shade trees. They should have their leaves and damaged roots cut off in transplanting and should be set about 3 feet deep in their new location.

[1] The palms are treated on the basis of notes furnished by Dr. O. F. Cook, of the Bureau of Plant Industry.

The Carolina palmetto[1] is a native of and useful in regions 12 and 13, where it sometimes attains a height of 60 or 80 feet. It will thrive in regions 3 and 5, but is used less there.

The Texas palmetto[2] is especially valuable for southern Texas, where it is indigenous, and it is likely to succeed generally in regions 3, 5, and 12. It grows to a height of 40 feet and in appearance is quite distinct from the Carolina palmetto, the leaf segments being much broader and less drooping.[3]

P18989HP

FIG. 27.—A formal planting on a city street. Palms with interplantings. Redlands, Calif., in midsummer.

The Victoria palmetto[4] is another hardy species, probably a native of Mexico, but grown for many years at Victoria, Tex. It is similar to the native Texas species and worthy of general planting in the same region. A feature of this species is that the persistent leaf bases remain alive and green for many years instead of turning yellow or brown, as in the Carolina palmetto.

WASHINGTONIA PALM.

Washingtonia palms are a very conspicuous feature of street and ornamental planting in southern California. Two species are represented, *Washingtonia filifera* Wendland and *W. robusta* Wendland. The first is a native of the canyons and barren slopes that surround the Coachella Valley of southern California, while the other species probably was brought by way of the Isthmus of Panama

[1] *Inodes palmetto* (Walt.) Cook.

[2] *Inodes texana* Cook.

[3] The Texas palmetto. *In* Jour. Heredity, v. 8, no. 3, p. 123, pl. 1917.

[4] Cook, O. F. A new ornamental palmetto in southern Texas. *In* U. S. Dept. Agr., Bur. Plant Indus. Cir. 113, p. 11–14. 1913.

from the region of San Jose del Cabo, the extremity of Lower California, in the early days of travel. The name *robusta* alludes to the fact that this species grows much more rapidly in height than *W. filifera*, though the trunk is more slender. Both species are hardy and thrive well through regions 2, 3, and 5, and also in regions 12 and 13. *Washingtonia robusta* requires less heat than *W. filifera*, but both will endure several degrees of frost. Even in California *Washingtonia robusta* is distinctly preferable for localities near the coast. In the vicinity of San Diego the leaves of *Washingtonia filifera* become badly infested with a parasitic fungus that does not attack *Washingtonia robusta*.

OTHER HARDY FAN PALMS.

The species most commonly used for street and ornamental planting in the California coast districts is the Chinese or windmill palm.[1] This palm has a slender trunk clothed with brown fibers, flat fan-shaped leaves, and rather straight radiating segments. The same species is hardy at New Orleans and Charleston, and even at Laurens, S. C., at an altitude of 600 feet, but it does not thrive in the sandy soil of Florida.

The vegetable hair palm,[2] a native of Spain, Sicily, and North Africa, is similar to the Chinese palm but smaller and more compact and with large, sharp spines on the petioles of the leaves. When young it suckers from the base, like the date palm, so that clusters of it may be formed.

The Guadeloupe Island palm[3] is one of the most popular species in southern California in the region of Santa Barbara, Los Angeles, and San Diego. This palm is a native of Guadeloupe Island, off the coast of lower California, and is not known to occur elsewhere in the wild state. It is well adapted to the cool coast climate of California, but not to the interior valleys. It is smaller than the Washingtonia palms, with a rather short trunk, 15 to 20 feet high, and a dense crown of fresh green leaves.

The California blue palm,[4] formerly placed in the same genus with the Guadeloupe Island species, is very distinct in habits as well as in general appearance, having bluish or grayish green leaves, strongly toothed petioles, and long, slender inflorescences. The trunk is very robust, often 2 to 3 feet in diameter, and is said to attain a height of 30 to 40 feet in Mexico. Several of these features are shared with the Washingtonia palms. It also has the ability to grow in the dry, hot interior valleys (regions 3 and 5). In Texas the blue palm has proved hardy at San Antonio, and even as far north as Austin.

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[1] *Trachycarpus excelsa* (Thunb.) Wendl.

[2] *Chamaerops humilis* L.

[3] *Erythea edulis* (H. Wendl.) S. Wats.

[4] *Glaucothea armata* (formerly known as *Erythea armata*). See Cook, O. F., Glaucothea, a new genus of palms from Lower California. *In* Jour. Washington Acad. Sci., v. 5, p. 236-241. 1915.

DATE PALM.

The Canary Island date palm[1] is the most popular palm for park or street planting, being more hardy than the true date palm, larger and more vigorous in growth, and producing no suckers from the base of the trunk. Well-grown specimens in the California coast districts (region 2) with trunks from 2 to 3 feet thick and immense crowns of spreading deep-green leaves are among the most imposing forms of plant life. Though less robust in other regions, the species is very hardy and adapted for planting anywhere in the palm belt (regions 3, 5, 12, and 13).

The true date palm[2] is adapted to the warmer parts of regions 3 and 5, but it is much inferior to the Canary Island species for ornamental use because the foliage is less attractive, due to its habit of sending out suckers from the base of the trunk.

THE COCONUT AND ITS RELATIVES.

The true coconut palm is confined to a narrow belt along the coast of southern Florida, but other species of cocos are planted in the coast districts of California. The species that is most prominent in park and street plantings around San Diego, Los Angeles, and Santa Barbara is usually known as *Cocos plumosa* or *Cocos romanzoffiana*, and is a rather tall, slender palm with a long-jointed trunk about 1 foot in diameter and long, spreading, feathery, deep-green leaves. Another series is represented by *Cocos yatay* and several similar species, often called *Cocos australis* in nursery catalogues. They have short, thick trunks, very glaucous grayish or bluish foliage, and fleshy edible fruits, highly flavored, somewhat like pineapples. These gray-leaved species are very hardy. Another coconut relative is the Chilean molasses palm,[3] which has a massive trunk 3 or 4 feet in diameter, specimens of which are growing at a few places in California.

OTHER PINNATE PALMS.

The amethyst palm, a native of Australia, is commonly planted in California. It usually appears in lists and nursery catalogues as *Seaforthia elegans* or *Archontophoenix alexandrae*, but it is now recognized as distinct from both of these species and has received a new name, *Loroma amethystina*. It is the only pinnate-leaved palm, except certain species of Phoenix and Cocos, that grows freely in the open air in the coast districts of California, from Santa Barbara to San Diego. In habit and general appearance Loroma is more like the royal palm, though with a smaller trunk and fewer leaves. The pinkish purple drooping inflorescence is very attractive and develops into a large cluster of scarlet berries.

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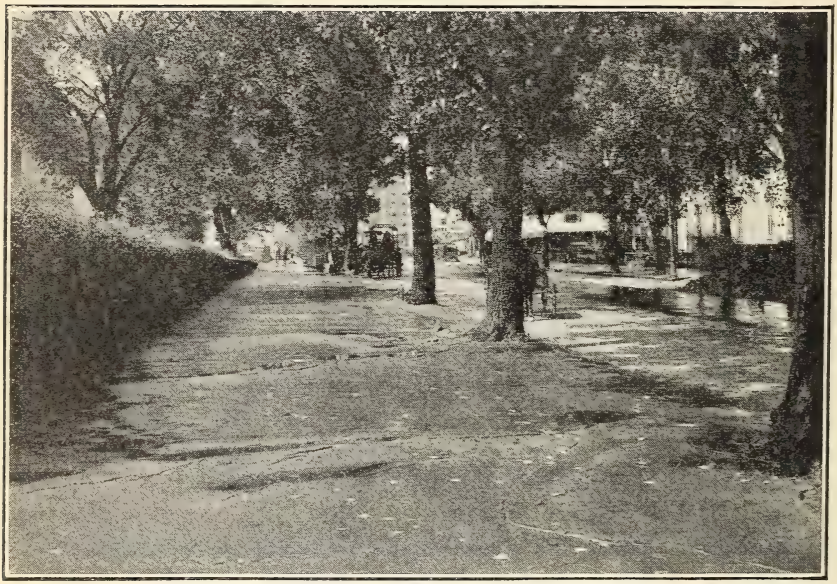
[1] *Phoenix canariensis* Hort. [2] *Phoenix dactylifera* L. [3] *Jubaea chilensis* Baill.

The royal palms, species of Roystonea, are perhaps the most striking ornamental members of the whole group. They can be grown in southern Florida and even exist in the wild state in some of the hammocks below Miami.

PEPPER TREE.

The California pepper tree[1] is much used in regions 2 and 3 and in the western part of region 5. It is a moderate-sized broad-headed tree with fine foliage, which gives it a light, airy appearance. During the fall and winter it is covered with scarlet berries, which in contrast with the persistent foliage produce a pleasing effect.



P12596HP

FIG. 28.—A pavement heaved by the roots of poplar trees.

POPLAR.

Poplars are not desirable for street planting. Their wood is brittle and easily broken by ordinary windstorms, and their roots run near the surface and are likely to interfere with pavements, as shown in figure 28, while those of some varieties are especially liable to make trouble in sewers by filling them with a mass of fibrous roots if access is once gained. Vigorous root growth is encouraged by the moisture from a leak, and the roots ultimately find their way inside.

The southern cottonwood,[2] Carolina poplar, and the northern cottonwood[3] are so similar in their adaptability for street-planting purposes that they will be discussed together. They are easily propagated, easily transplanted, are quick growing, and where they

[1] *Schinus molle* L. [2] *Populus deltoides* Marsh. [3] *Populus virginiana* Fouger.

reach maturity under normal conditions form very large oval-headed handsome trees, but under the artificial conditions existing in cities it is necessary to prune them quite severely when young to remove the long vigorous growths and make the heads more compact. This pruning stimulates more vigorous growth, which must be removed or they will form long branches with heavy tops, that are especially liable to be injured by windstorms. The more they are pruned the greater the tendency to an undesirable form of growth. They begin dropping their leaves early in the summer and lose them very early in the autumn. Their root growth is especially vigorous, so that they are liable to make trouble in sewers in the manner already mentioned. It is largely on this account that many cities prohibit the planting of these trees. Except in regions 6, 7, or 8 or in locations where smoke and fumes in the air prevent the growing of other trees, they should not be planted.

The Lombardy poplar[1] is a tall columnar tree adapted for use on very narrow streets (fig. 14). It is short lived in many places, due largely to the European poplar canker, but otherwise is a satisfactory tree for these conditions in all parts of the United States. The trees may be planted as close together as 30 feet.

None of the other poplars have much to recommend them for street planting.

RUBBER TREE.

The rubber tree[2] is a large-headed handsome evergreen, suitable for regions 3 and 5 and the southern parts of regions 2 and 13 when the use of an evergreen tree is warranted.

SILK OAK.

The silk oak,[3] or Australian fern, is a large, handsome tree that succeeds well in regions 2, 3, and 13; also in region 5 if provided with a reasonable amount of moisture, as it stands drought remarkably well. It is covered in early summer with orange-colored flowers.

SWEET GUM.

The sweet gum[4] is adapted to regions 11, 12, and 13, especially on sandy lands. It forms an oval-headed, handsome tree with star-shaped leaves that assume a particularly brilliant hue in the autumn. It is better adapted to suburban conditions than to the heart of a city. Toward the northern limits of its successful cultivation it is difficult to transplant, while in the warmer sections of the country it can be moved with comparative ease. It should be transplanted only in the spring.

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[1] *Populus italica* (Du Roi) Moench.
[2] *Ficus elastica* Roxb.
[3] *Grevillea robusta* A. Cunn.
[4] *Liquidambar styraciflua* L.

SYCAMORE.

The sycamore,[1] also called the buttonwood and buttonball tree, is a large, open, spreading, quick-growing tree native along watercourses. It is adapted to regions 1, 2, 3, 4, 9, 10, 11, 12, and 13 and is worth testing in regions 5, 6, 7, and 8. Its habit of shedding its outer bark in large flakes, leaving the white new bark showing in large patches, makes it a conspicuous tree wherever grown. The fruits are balls 1 inch or more in diameter and are sometimes objected to because they make dirt when falling; also the shed bark is considered objectionable. It is such a strong-growing handsome tree and succeeds so well under city conditions that it is being planted more and more frequently. It will stand more pruning and shaping than any other street tree. Without pruning it is too large for ordinary streets unless spaced at almost double the usual planting distance, with the trees staggered along the street instead of being planted opposite. Its high head and open habit of growth are distinct advantages for street planting. Its foliage, too, is a light green, which gives an impression of airiness with the shade. It is subject to attack by a fungus that kills the leaves while still small or partially mutilates them, giving them an unsightly appearance. In some places this trouble is quite serious.

The California sycamore[2] is a native of California adapted to regions 1, 2, 3, and 4 and portions of region 5. It is similar in general characteristics to the sycamore.

The London plane tree[3] is one of the Old World forms of sycamore. According to Alfred Rehder,[4] "the true oriental plane is rare in cultivation, the tree usually planted under this name being *Platanus acerifolia*." It it more compact in habit of growth and has the other good qualities of the sycamore. It is being more and more used on city streets and is proving satisfactory in regions 1, 2, 3, 4, 9, 10, 11, and 12. It will probably succeed in the warmer parts of regions 6 and 7 and also in regions 5 and 8. It is a more desirable tree for ordinary use than the sycamore, on account of its more compact habit and comparative freedom from disease, though it is tender in the northernmost sections.

TULIP TREE.

The tulip tree[5] is also sometimes called the tulip poplar or yellow poplar, though the latter names are unfortunate, as the tree is not a poplar or even closely related to the poplars. It is a large, rapid-growing tree suitable for suburban conditions in regions 1, 2, 10, 11,

[1] *Platanus occidentalis* L.
[2] *Platanus racemosa* Nutt.
[3] *Platanus acerifolia* (Ait.) Willd.
[4] Bailey, L. H., ed. New York, 1916. Standard Cyclopedia of Horticulture, v. 5, p. 2707.
[5] *Liriodendron tulipifera* L.

and 12. The leaves are of unusual form, the upper half appearing to have been cut away, leaving a notch about where it would seem the middle of the leaf should be. The color is a light green. The roots are unusually soft and tender, and therefore the tree needs to be transplanted quickly and with great care. Small sizes should be planted, especially near the northern limits of growth. It should be transplanted only in the spring. If after transplanting it the top should die and a new vigorous shoot should put out from the root, it would be desirable to form a new top from this shoot rather than to transplant another tree.

CULTURE OF STREET TREES.

SELECTION OF INDIVIDUAL TREES.

Nursery-grown trees should be used for street planting, and they should have been transplanted at least every two years while in the nursery. This is to insure a thorough root pruning and the production of numerous fibrous roots close to the trunk. Trees not frequently transplanted form a few long roots that are largely cut off when the tree is dug. Trees growing in the woods form a few very long roots, and when an attempt is made to dig them only a little of the root next the trunk is obtained, while most of the roots, including the fibrous ones, are left in the ground. If woodland trees are wanted for street purposes, most kinds should be grown for a few years in a nursery in order to form a good root system before being planted on the streets.

In addition to a good root system, the tree should have a straight trunk for the variety, with a good set of branches, called the head, the bottom branches being from 7 to 9 feet from the ground. Trees which naturally head low should be started with a higher head than those varieties that have a tendency to an upright growth. A good head for a shade tree is a leader or upright branch with three or more side branches about equally spaced around the tree. The trees should be healthy, free from scars, and also free from evidences of insects or diseases. In the presence of insects, trees should be thoroughly fumigated along approved methods before leaving nurseries, to insure against the introduction and distribution of pests. Weakened vitality resulting from transplanting and subsequent neglect will frequently invite attack by bark-boring insects which seriously damage or kill the trees. Mulching and watering will often prevent this damage.

Opinion as to the size to plant differs somewhat, but for average conditions trees from 10 to 12 feet high and with trunks or stems from 2 to $2\frac{1}{2}$ inches in diameter [1] are very satisfactory in most

[1] Designated by nurserymen as "caliper."

varieties used for street purposes. With such varieties as elms, sycamores, and some southern oaks, somewhat larger trees can be used equally well, while smaller trees would be better in the regions of limited rainfall both east and west of the Rocky Mountains and for tulip trees and sweet gums, especially in the northern portion of their range of usefulness.

PREPARATION OF HOLES.

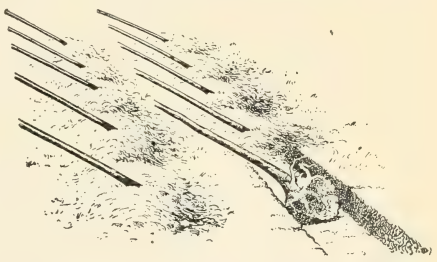
Next to the selection of a proper variety, the preparation of the hole is the most important detail of street-tree planting. Because of the restricted area available for the spread of the tree roots, and owing to the artificial conditions imposed by the improvement of city streets, the soil provided for the feeding ground of the roots of the young tree must be liberal in quantity and of the best quality. From 2 to 3 cubic yards of soil should be provided for each tree. It is desirable to have at least 18 square feet of opening in the sidewalk, especially if it is of concrete or other impervious material. Trees will grow with smaller sidewalk openings, but they are not likely to thrive so well, and it is impossible properly to prepare a hole for planting a tree without disturbing at least this much surface soil. The proper depth of soil is from 2½ to 3 feet. A hole 3 feet deep large enough to hold 2 cubic yards of soil has a surface area of 18 square feet. A hole 6 feet long, 3 feet wide, and 3 feet deep will hold 2 cubic yards of soil, will have the smallest desirable surface area, and will be of such dimensions as will best conform to the usual sidewalk and roadway widths and thus not interfere with traffic.

The tree hole must be so drained that water will not stand in it. If the soil is so impervious as to hold water some artificial drainage must be provided. That portion of the depth of a hole that acts as a cistern for holding water is valueless as a feeding ground for roots. For every cubic foot of soil in the bottom of a hole that might thus be made valueless by standing water, 1½ cubic feet of soil should be added by increasing the length or width of it. Under no circumstances, however, should the depth of available feeding ground be less than 2 feet. The deeper the roots may be encouraged to grow, the less injury is likely to be experienced from drought.

The soil used should be topsoil from land that has been producing good crops. This should be well enriched with rotted manure, one part of manure to four of soil. The addition of such fertilizers as ground bone, tankage, fish scrap, or cottonseed meal at the rate of 1 pound to the cubic yard of soil is also helpful Commercial fertilizers containing mostly phosphoric acid obtained from other substances than ground bone are not to be recommended for use in the soil about the roots at planting time. When used they should form a surface application, worked into the soil after planting.

PLANTING.

If trees are shipped from a distance they should be taken at once on arrival to some point where the roots may be carefully covered with soil; there they should be unpacked and plenty of loose moist earth worked thoroughly around and over the roots as fast as they are taken from the box. This temporary covering of the roots is called "heeling in." (Fig. 29.) The tops may be either erect or laid almost on the ground in successive rows, the tops of one row lying over the roots of the previous rows, the object being to cover the roots thoroughly and keep them moist until the tree is wanted for permanent setting. Not a moment of exposure should be permitted between the box and the soil. If the roots appear dry, they may be dipped for a few minutes before heeling in in a tub of water or in thin mud.



P20370HP

FIG. 29.—Trees properly "heeled in."

Trees in large quantities are often packed directly in cars with a small quantity of straw about the roots. When shipped in this way

P20000HP

FIG. 30.—Trees handled in a careless manner. The roots should have been covered with wet canvas.

extra care (compare figs. 30 and 31) must be exercised in taking the trees to the point where they are to be heeled in. The wagon in which they are to be hauled should have a tight box, and wet canvas should be tied tightly over the load. The last is important, so that there may be no chance for the roots to dry.

When taking trees from the ground where they have been heeled in to the place for planting, great care must also be exercised to see that the roots are not exposed to sun or wind, but are kept closely covered with moss, wet burlap, or canvas until planted. Lack of care in this matter is a greater cause of loss in tree planting than carelessness in any other particular. One city that has its own nursery and uses largely trees that are supposed to be difficult to move, but is careful about not exposing the roots for a moment (fig. 31), has a loss of less than 1 per cent. If the roots once dry the trees will die, and it takes but a short exposure to dry the roots. The holes should be

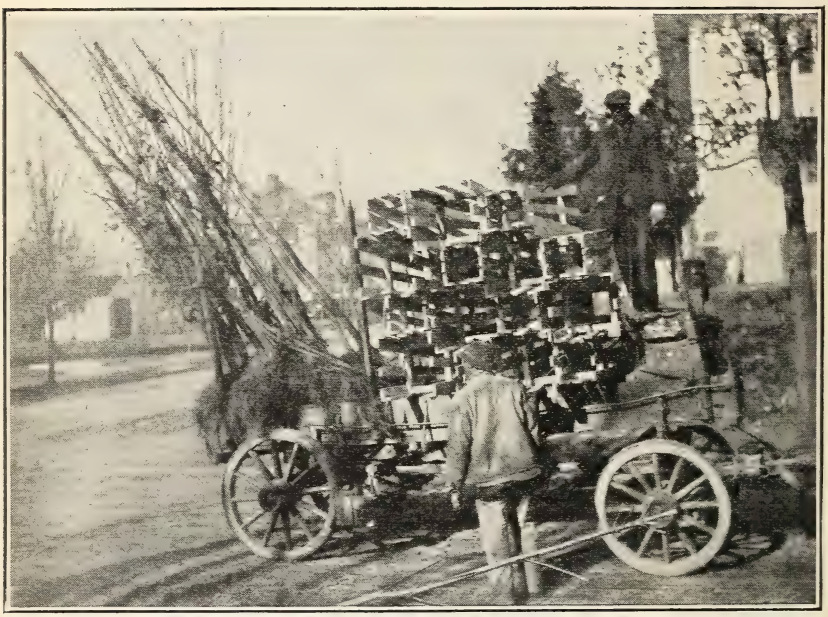


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FIG. 31.—A load of trees and tree boxes. The roots are packed in wet moss and a tree is not taken from the wagon until the planter and two shovelers are at the hole where it is to be planted.

prepared well in advance of planting, so that no time will be lost when conditions are right for putting the trees in the ground.

In regions 1, 10, 11, 12, and 13 (fig. 17) the best time for planting deciduous street trees is the month or six weeks just preceding freezing weather in the fall. The other desirable time for planting is as soon after freezing weather is over in the spring as the ground is dry enough for the mechanical operations. This should be as early as possible, as the more opportunity there is for root growth before warm weather forces the top into growth, the better the results are likely to be. In regions 6, 8, and 9, where the ground freezes to a considerable depth, spring planting is to be preferred to fall planting unless it is possible to drench the soil thoroughly for a considerable distance around the trees at planting time and after that to mulch

the soil thoroughly and also to protect the top from the effect of drying winter winds. Where mice abound they may be harbored in the mulch and may girdle the tree. This may be prevented by a collar of wire netting about the base of the trunk or by banking the earth about it. The death of trees at the time of transplanting is due to the drying out of either roots or tops before opportunity is given them to become reestablished in their new locations. This drying may be due to improper exposure at the time of digging or before packing (fig. 30), poor packing, prolonged delay in delivery, improper handling between unpacking and planting, or the existence of conditions conducive to excessive drying out of the plant after setting.

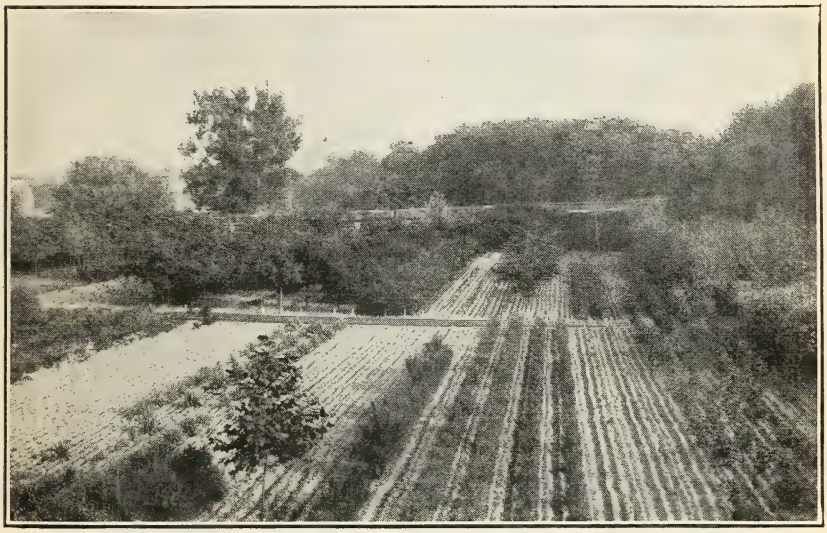

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FIG. 32.—A city nursery.

The atmosphere is continually claiming a tribute of moisture from all living plants, whether the plant is in leaf and growing or is dormant. Growing plants, and dormant plants under normal conditions, are able to replace this moisture by absorption through the roots. In climates where newly planted trees may obtain sufficient soil water to replace these losses by drying, fall planting is best. Where the plants are unable to get sufficient winter moisture, planting would better be done only in the spring. Where the soil freezes to a depth greater than that to which the plant roots extend, the supply of water is cut off from the roots and the tree will be killed by drying out through evaporation from the top. Where winter winds are very drying and the soil moisture is limited, evaporation from the top is likely to be in excess of that supplied by the roots and the tree is killed in the same way.

In regions normally adapted to fall planting, newly set trees may be killed by a dry autumn followed by a dry winter with high winds or by a cold winter with so little snow that the ground freezes below

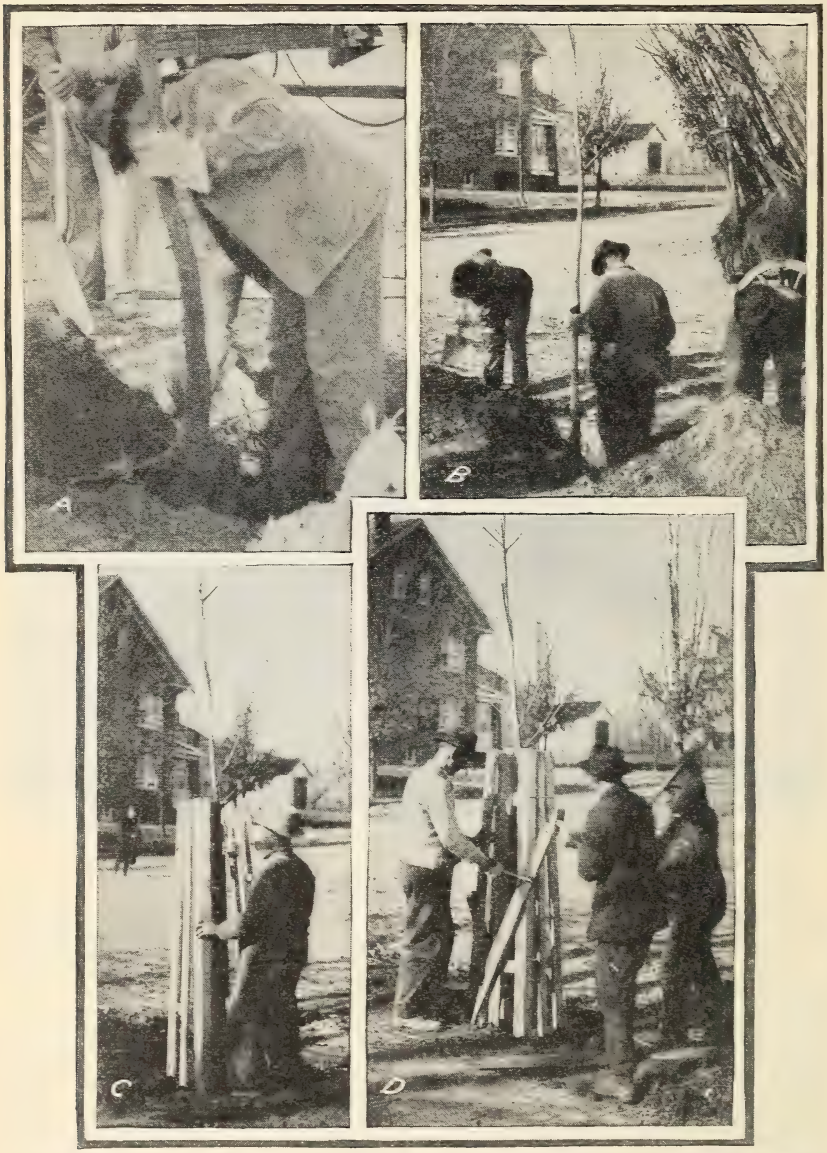

FIG. 33.—Setting a tree: *A*, Measuring from the curb to get the tree in line; *B*, filling the hole; *C*, placing the box; *D*, fastening the box.

the roots. On the other hand, trees may often be successfully planted in the fall where such practice is not usually successful by thoroughly mulching the soil if freezing is the sole cause of the difficulty, or by

drenching the soil thoroughly and then mulching well if lack of moisture and high winds are the causes of the trouble. Protection from the wind by wrapping the trunk and large limbs with burlap or some other protecting material is also desirable.

After a liberal opening has been made in the specially prepared soil the tree should be brought, preferably from the city's own nursery (fig. 32), but if such a nursery has not been provided, then from among the newly received trees that have been "heeled in," as already described.

If the tree has been well handled and the roots carefully protected it is ready for setting. It is desirable to immerse the roots in a thin mixture of clay and water just before putting it in the hole if there is suspicion that the roots have been exposed. This can be done before leaving the nursery or "heeling-in" ground, but the roots must be properly protected. Any mutilated ends of roots should be removed, the top should be severely pruned, as described later, and the tree should be placed in the hole in line with the other trees (fig. 33, *A*) and at such a height that after the filling is completed it will be about an inch deeper in the ground than it was before transplanting. The roots should be spread out in as near their original position as practicable, and soil should be carefully worked in about them with the fingers, so that each rootlet may come in contact with soil and not be crowded against other rootlets. When all the roots have been placed and covered the soil should be thoroughly trampled or tamped to bring the roots into as close contact as possible with it. Then more soil should be put in and the ground again tamped. Of course, in order to get satisfactory results the soil used for planting must not be too wet or too dry. If the soil is in such a state as to hold together in soggy masses and not spring apart again when squeezed in the hand, it is too wet for planting. If the soil is too dry, it will not stay in contact with the roots during the planting operations. A soil that is too dry may be well watered a day or two in advance of the planting, or if excessive dryness does not make it difficult to handle, the tree may be planted and then be thoroughly watered. After the watering 3 or 4 inches of loose soil should be spread over the wet ground in order to prevent undue evaporation. It should not be trampled or pounded in any way after the water is applied. If trees planted in moist retentive soils are watered after planting they should be provided with a mulch of similar earth. East of the Missouri River trees planted in soil that is in good condition usually do not need watering at the time of planting.

Trees planted from pots, cans, or boxes should have the ball of earth taken from the receptacle handled with care, so as not to break it further than to loosen some of the roots on the outside of the ball; then the soil should be as carefully placed about this ball

and the loosened roots as about the roots of trees without balls. Trees planted with balls need no root pruning and little top pruning.

PRUNING.

At planting time the trees should be so pruned as to remove from one-half to three-fourths of the leaf buds. The head should be formed in the nursery, so that at planting time the only problem is how to reduce the amount of prospective growth the first season

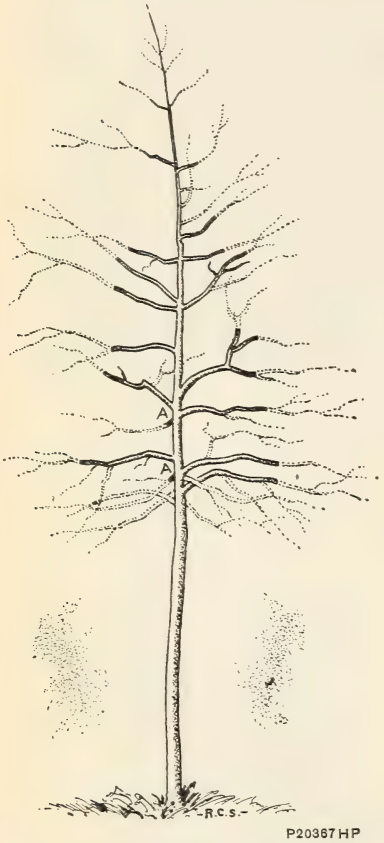

FIG. 34.—A pin oak trimmed for planting. Note the bad stubs (*A*, *A*) on the left-hand side of the tree.

FIG. 35.—A sycamore trimmed for planting. Well pruned, without bad stubs.

without destroying the form of the head. Specific directions are difficult, because different species of trees are so different in their character of growth. A species that is naturally compact in growth (fig. 34) should be pruned by removing whole branches rather than by having the ends of branches removed. One that is open and spreading (fig. 35) will probably need the shortening of the longer limbs as well as the removal of interior branches. The first pruning

should be the removal of such branches as can be spared. If enough buds can not be removed in this way without leaving the head too open, then the shortening of the branches must follow. It is usually necessary to remove three-fourths of the limbs to accomplish this. An expert can do this pruning or most of it more easily before the tree is planted than afterwards. Some additional pruning may be necessary after the tree is set.

In addition to the pruning of the top the roots may need some cutting. Any broken pieces or ends should be removed, making a clean cut with a sharp knife, as new rootlets put out more readily from a cleanly cut fresh surface than from ragged breaks. If the roots are very long, without branches or rootlets, it sometimes makes planting easier to cut off some of the ends. As roots are the braces

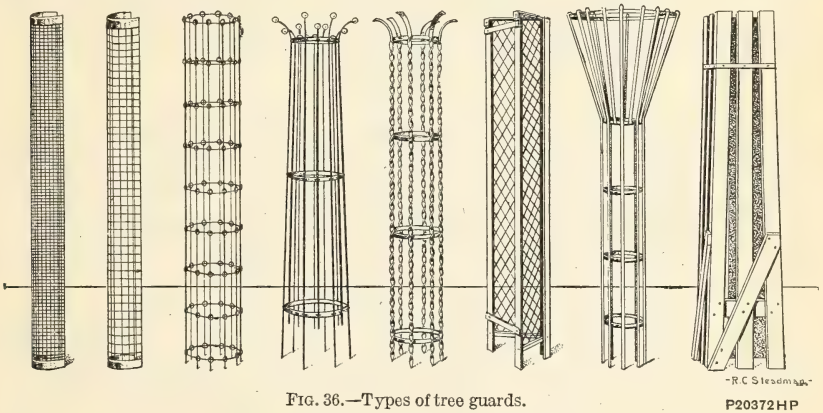

FIG. 36.—Types of tree guards.

by which a tree is supported in the ground, it is undesirable to reduce their length unless some positive good is to be gained by it.

The best implement for cutting small limbs is a sharp knife, and for larger limbs a fine-toothed saw. Pruning shears are sometimes used, but they are likely to bruise the wood. If used at all, the blade should always be turned toward the tree so that the bruise made by the supporting bar will be on the portion cut off. Where branches are taken off, the cut should be close to the remaining limb, so that no suggestion of a stub will remain. (Figs. 34 and 35.) Where ends are cut from branches the cut should be just above a bud, and the remaining bud should point in the direction that it is desired the limb should grow.

STAKES AND GUARDS.

Under city conditions young trees need the support of a strong stake as well as protection for the trunk. Boys like to swing around small trees or see the tops fly up if bent to the ground. Men find them convenient hitching posts for their horses, and horses frequently

like the taste of the bark or tear it off for the sake of having something to do.

Guards are of many forms (fig. 36), from stakes 2½ inches square set 3 feet in the ground and extending 6 feet above, with heavy netting placed about the tree and stapled to the stake, to heavy wooden cribs of four stakes and intermediate slats and wrought-iron patterns of many forms.

The trees should be firmly secured to the tops of the guards so that they will not swing against them in the wind and be rubbed. This is best done by securing the tree in place in the guard by two loops of pieces of old garden hose, soft leather, or rope, in such a way as not to bind the tree too tightly while keeping it from swinging much or rubbing. The essentials are a firm support for the tree while young with reasonable protection of the trunk from careless depredations until the tree has reached a diameter of 6 inches or more.

LATER CARE.

If after planting, the season is dry and it becomes necessary to apply water, the ground should be soaked thoroughly, and as soon as it has dried sufficiently to work up loosely it should be hoed or raked to make a good earth mulch. A mulch of strawy manure or litter may be used in place of the earth mulch if desired. The watering should not require repeating for a week or more.

If the weather becomes warm soon after planting and the trees come into leaf, wither, and droop, further pruning may save them. The reason for the difficulty is probably that the growth of the top has been greater than the newly formed roots can support; therefore the additional pruning is likely to restore the balance between the top growth and root growth. At least three-fourths of the remaining young wood should be removed. This may leave the tree looking almost like a bean pole, but if it induces a vigorous root growth the top can easily be re-formed.

Young trees should have an annual inspection, and all crossing branches and any that are not well placed to form a good head should be removed. Attention should be given also to all forks, and where two branches start almost parallel to one another or at a small angle, making a fork liable to split apart as the tree grows, one branch should be removed. Where three branches start from almost the same point there is little likelihood of their splitting apart, but with only two growing at a less angle than 30° there is liable to be trouble in the case of most kinds of trees. On trees on which few but long shoots form, it may be well to remove the ends of such shoots. As a rule, it is undesirable to use for street planting trees with this kind of growth. Young trees should be trained into a desirable shape by the use of a pruning knife each year, so that a saw will not be necessary later. Some trees have a tendency to

form too dense a head. The interior branches of these should be removed and the head made as open as possible while the work can be done with a knife. No attempt should be made to alter the natural form of a tree but only to insure its best development. A skillfully pruned young tree will show no evidences of the pruning after three or four years.

CARE OF MATURE TREES.

PRUNING.

It is very little trouble to train a tree into a good shape by using the pruning knife while the limbs are small, but it is usually difficult to re-form a tree after it has grown to maturity. One who understands tree growth, however, can often reshape the top of a neglected tree to advantage, though many who make a business of tree trimming know so little about it that they do more harm than good. More mature trees have been hurt by severe pruning than have been helped. Of course, dead or dying wood should be removed whenever it is found, no matter what the age of the tree. This should be done by cutting off the limb back to the nearest healthy crotch. A limb should not be cut off square across (fig. 21) unless the tree is apparently in a dying condition and the whole top is treated thus in an attempt to save its life. In such a case, a second pruning should follow within two years, at which time the stubs left at the first trimming should be cut off in a proper manner near the newly started limbs. Healthy silver maples and willows are frequently cut in this way, but the maples in particular would better be cut down at once than to subject the public to the dangers of the insidious decay that almost always follows such an operation on these trees and completes their destruction promptly.

Trees that have been neglected a long time frequently have interfering or crossing branches, or are too low headed or too densely headed for the place where they are growing. Defects of this kind may be at least partially remedied. The removal of limbs by cutting them off at a crotch in such a manner that the wound is parallel with the remaining branch (fig. 37) inflicts the least possible damage. Such a wound in a healthy tree will soon heal over if the cut is made through the slight collar or ring that is nearly always present at the base of a branch. The closer this cut can be made to the trunk the better the appearance when the cut is healed. The closer the cut the larger the wound, but the difference is unimportant if the wood is well protected until it is healed. These operations are entirely different in purpose and result from the "heading in" or "heading back" so often practiced under the guise of tree pruning, either from a false notion of forming a top or for the passage of wires.

Changing the form of a tree by pruning should not be attempted. Each species has its own form or forms, and no attempt should be

made to change or distort a tree from its normal habit of growth. Successful pruning will accentuate rather than disguise a tree's characteristics.

All cuts should be made so that no stubs or protuberances are left to prevent quick healing. Small wounds need no after treatment if the cut is well made. Large wounds should have the wood of the center of the cut well protected to prevent decay until the new growth has had an opportunity to heal over the cut. An application made to the center of the cut to preserve the wood should not be permitted to come near the cambium layer or inner bark, especially of soft-wooded trees like the tulip and magnolia, as the oil or other substances contained in the paint, tar, or other covering may spread to the cambium layer and kill it. It is well not to make any application within half an inch of the outside of the wound unless the coating has been thoroughly tested.

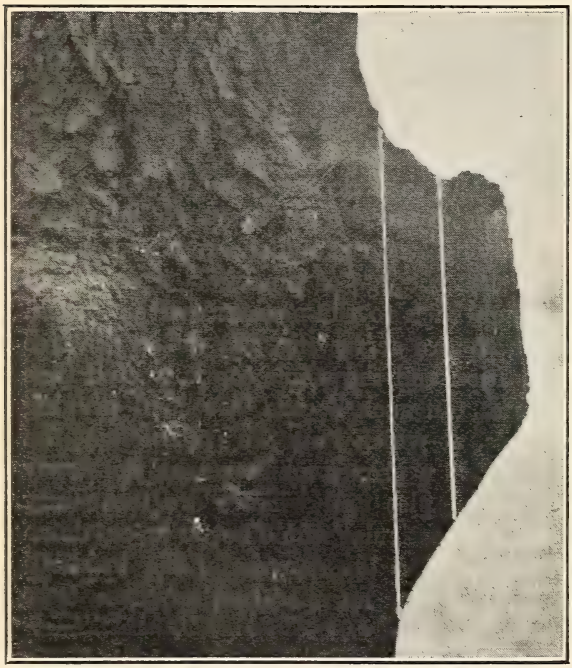

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FIG. 37.—Part of a tree trunk showing proper and improper methods of removing old limbs. Although healing has started on the stub (at the right) it is likely to proceed very slowly. The nearer the cut is to the tree the larger the wound but the less conspicuous the stub will be when healed.

Dead wood should be entirely removed, the cut being made through good live tissue. Removing such wood frequently exposes decayed cavities, usually from bad stubs or injuries which have started decay that has followed back to the main limbs or the trunk. The treatment of such cavities is the province of tree surgery and is discussed in another publication.[1]

One source of trouble with a large tree that has developed with two trunks or branches instead of three or more is the liability of their splitting apart in the crotch. This is especially characteristic of the elm. Careful attention to the early pruning of trees may eliminate

[1] Collins, J. F. Practical tree surgery. *In* U. S. Dept. Agr. Yearbook, 1913, pp. 163–190, pl. 16–22. Published as Yearbook Separate 622, obtainable from the Superintendent of Documents for 10 cents in coin.

this defect, but when it exists in mature trees it is frequently advisable to connect the branches by a strong chain (fig. 18) in order to prevent the limbs from being torn apart.

FEEDING.

It is difficult to do anything to stimulate the growth of street trees after they are once started, because usually the only uncovered area over the roots is the small opening immediately about the tree; hence, the importance of supplying the best of soil well enriched at the time of planting. Sometimes a stimulation is desirable, which can be accomplished by dissolving one-half to 1 pound of nitrate of soda in 50 gallons of water and applying from 1 to 25 gallons of the liquid, depending on the size of the tree. Unless the soil is damp at the time of application water will be needed immediately afterward. This material should be applied only when the tree is in full leaf and growing. If applied when the tree is dormant it is likely to be leached from the soil before it is absorbed. If applied late in the season, that is, within three months of freezing weather, it would likely stimulate a late growth that would be liable to be killed the following winter and might make the whole tree more susceptible to injury from cold.

Water is one of the great needs of city trees, as the ground surface is often almost completely roofed over with water-tight coverings. It is usually a help for the pavement washings to drain into the parking space where the tree is planted. If a curb is placed about the parking space, frequent, regular watering is necessary where the ground is thoroughly covered with water-tight pavements.

Where growing under suburban conditions, that is, with streets partially pervious to water, liberal parking spaces, and adjoining lawns, street trees will respond to all extra care given the near-by open spaces, whether parkings, lawns, or gardens. If these are well cared for the trees should have ample sustenance from them without any direct applications.

In order to prevent the soil about a tree from being packed too hard by trampling it is frequently desirable on business streets to cover the soil about it with an iron grating.

SPRAYING.

Street trees, like all other forms of vegetation, are subject to attacks of insects and diseases. Because of the unfavorable conditions under which they grow, spraying for biting and sucking insects and suitable treatment for borers or other burrowing insects require especially careful attention.

In addition to a number of troubles common to street trees in general, each species is liable to troubles of its own; hence, the need of competent supervision by a trained man with an efficient outfit rather than leaving the work to individual initiative.

Because of the height which many street trees attain a powerful outfit is required to spray them properly. One capable of maintaining a pressure of 200 pounds per square inch is desirable. The type of spray required for tall trees is different from that used on fruit trees and other low plants. For low trees the ideal spray is a mist within a few feet of the nozzle, application being accomplished by having the nozzles near the foliage to be treated. For tall trees it is desirable that the liquid should leave the nozzle in a solid stream, which is broken into spray as it passes through the air. The material has to be projected with sufficient force to reach the highest trees before being entirely converted into mist, as it is impracticable to extend the nozzles into the trees to reach the farthest portions, as is done with fruit and other low trees. The spray can not be applied as uniformly as a mist, but it is impracticable to climb into the tops of shade trees to cover every part with a cloudlike spray. On the other hand, the mist spray is better for small trees, as much injury may be done to low trees or to the lower branches of high trees by the force of the stream from high-pressure outfits.

It is estimated that in practice up to 95 per cent of the attacking insects can be killed with insecticides carefully applied by the stream method under high pressure.

In addition to the mechanical problem of satisfactorily covering high trees with insecticides or fungicides there is the problem of selecting materials that will be effective against the insects and diseases and at the same time will not disfigure the paint or stone work of adjacent buildings with which the materials must inevitably come in contact in street-tree spraying. It frequently happens that the most effective remedies must be rejected because of the damage they would do to buildings and that less efficient materials must be used.

Whitewashing the trunks of trees is a useless and unsightly practice—useless, as it does not prevent the attacks of insects, and unsightly, because it makes the trunks of the trees obtrusive when they should be inconspicuous.

Banding with cotton or proprietary preparations may occasionally be useful, but because such applications are so seldom helpful and because some of the preparations result in injury due to constriction of the trunks, it should not be resorted to except upon special recommendation of an entomologist familiar with the existing conditions.

Details as to enemies to be expected, methods of treatment, and materials to be used may be found in other publications [1] or may be obtained by correspondence with the nearest State agricultural experiment station or with the United States Department of Agriculture.

[1] See list on following pages.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO DISEASES AND INSECTS AFFECTING SHADE AND ORNAMENTAL TREES.

AVAILABLE FOR FREE DISTRIBUTION.

Control of Root-Knot. (Farmers' Bulletin 648.)
The San Jose Scale and Its Control. (Farmers' Bulletin 650.)
The Bagworm, an Injurious Shade-Tree Insect. (Farmers' Bulletin 701.)
The Catalpa Sphinx. (Farmers' Bulletin 705.)
The Leopard Moth: A Dangerous Imported Enemy of Shade Trees. (Farmers' Bulletin 708.)
The Oyster-Shell Scale and the Scurfy Scale. (Farmers' Bulletin 723.)
The White-Pine Blister Rust. (Farmers' Bulletin 742.)
Carbon Disulphid as an Insecticide. (Farmers' Bulletin 799.)
The Gipsy Moth and the Brown-Tail Moth and Their Control. (Farmers' Bulletin 845.)
Common White Grubs. (Farmers' Bulletin 940.)
The Blights of Coniferous Nursery Stock. (Department Bulletin 44.)
Forest Disease Surveys. (Department Bulletin 658.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

The Mistletoe Pest in the Southwest. (Bureau of Plant Industry Bulletin 166.) Price, 10 cents.
The Death of Chestnuts and Oaks Due to Armillaria mellea. (Department Bulletin 89.) Price, 5 cents.
New Facts Concerning the White-Pine Blister Rust. (Department Bulletin 116.) Price, 5 cents.
The Huisache Girdler. (Department Bulletin 184.) Price, 5 cents.
Report on the Gipsy Moth Work in New England. (Department Bulletin 204.) Price, 30 cents.
A Disease of Pines Caused by Cronartium pyriforme. (Department Bulletin 247.) Price, 5 cents.
Food Plants of the Gipsy Moth in America. (Department Bulletin 250.) Price, 10 cents.
Dispersion of Gipsy-Moth Larvæ by the Wind. (Department Bulletin 273.) Price, 15 cents.
The Cottonwood Borer. (Department Bulletin 424.) Price, 5 cents.
Solid-Stream Spraying against the Gipsy Moth and the Brown-Tail Moth in New England. (Department Bulletin 480.) Price, 15 cents.
Protection from the Locust Borer. (Department Bulletin 787.) Price, 5 cents.
Principal Insects Liable to be Distributed on Nursery Stock. (Entomology Bulletin 34, n. s.) Price, 5 cents.
The Locust Borer. (Entomology Bulletin 58, part 1.) Price, 5 cents.
Additional Data on the Locust Borer. (Entomology Bulletin 58, part 3.) Price, 5 cents.
The San Jose or Chinese Scale. (Entomology Bulletin 62.) Price, 25 cents.
Report on Field Work against the Gipsy Moth and the Brown-Tail Moth. (Entomology Bulletin 87.) Price, 35 cents.

The Importation into the United States of the Parasites of the Gipsy Moth and the Brown-Tail Moth. (Entomology Bulletin 91.) Price, 65 cents.

The Dispersion of the Gipsy Moth. (Entomology Bulletin 119.) Price, 20 cents.

The Green-Striped Maple Worm. (Entomology Circular 110.) Price, 5 cents.

The Oak Pruner. (Entomology Circular 130.) Price, 5 cents.

The Dying Hickory Trees: Cause and Remedy. (Entomology Circular 144.) Price, 5 cents.

Flour Paste as a Control for Red Spiders and as a Spreader for Contact Insecticides. (Entomology Circular 166.) Price, 5 cents.

Three Undescribed Heart-Rots of Hardwood Trees, Especially of Oak. (Journal of Agricultural Research, vol. 1, No. 2.) Price, 25 cents.

A Serious Disease in Forest Nurseries Caused by Peridermium filamentosum. (Journal of Agricultural Research, vol. v, No. 17.) Price, 10 cents.

The Chestnut Bark Disease. (Separate 598, from Yearbook of the Department of Agriculture for 1918.) Price, 10 cents.

Practical Tree Surgery. (Separate 622, from Yearbook of the Department of Agriculture for 1913.) Price, 10 cents.

Forest Tree Diseases Common in California and Nevada. (Forest Service Unnumbered Publication.) Price, 25 cents.

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